THE

Malayan Agricultural Journal.

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EDITORIAL.

Rice in Malaya.

The present enlarged number of this Journal contains articles relating to the crop which forms the staple food of the great majority of the population of Malaya, namely rice.

For the two decades between 1910 and 1930, the production and export of rubber dominated the agricultural outlook in Malaya by reason of the large profits obtained from its sale, but even during this period the Malay peasant continued, somewhat reluctantly, to till his ancestral padi field, leaving the tapping of his rubber trees to a paid labourer. In the first of these decades, the Department of Agriculture, so far as the limited staff available during the war period would allow, endeavoured by the selection of high yielding strains of padi at the Titi Serong Experiment Station to increase the crop obtained from the area then cultivated.

The rubber slump of 1921, corresponding as it did with a shortage in the world's rice supply, administered a severe shock to the edifice of agricultural prosperity erected on the weak foundation of a single export crop.

It was not, however, until the advent of the world wide economic depression that it became widely recognised in Malaya, as it has been in neighbouring countries, that a sound, agricultural policy requires the striking of a proper balance between the production of food supplies for local consumption and the cultivation of other crops for export.

After three years of depressed prices for export crops, the moment seems opportune for reviewing the effect of this depression on the production of the staple food of Malaya.

The first article in this number of the Journal contains a general survey of the rice position in Malaya in 1933, and an outline of the developments which have occurred in recent years. Three points stand out plainly from this article, the first is that while the average production in Malaya during the period 1922 to 1930 showed only such variation from a mean of 200,000 tons per annum as was due to annual variations in climatic factors, the average production during the last three years has increased to 278,000 tons. The second is that this increase in production is due both to increase in the planted area and to increase in the average crop obtained per acre, the latter being attributable not only to

favourable conditions, but to more thorough methods of cultivation and to a wider use of the higher yielding selected strains of padi. The third point is that the fall in imports during the last three years is due not only to the reduction in population caused by the repatriation of Indian and Chinese labourers from the mines and estates, but equally to the extent to which increased production has replaced imports.

The next three articles give an account of the work which is being undertaken by the Department of Agriculture, S.S. and F.M.S., and the Departments of Agriculture in Kedah, Kelantan and Johore to increase the crop obtainable from the existing planted area in the Peninsula.

The first two of these by Dr. H. W. Jack and Mr. W. N. C. Belgrave respectively summarise the work carried out during the season 1932—33 by the officers of the Field Branch of this Department, and of the Departments in the Unfederated Malay States already mentioned, on the Padi Experiment Stations and on the Demonstration Stations and Test Plots that have been established in various parts of the different States and Settlements. All this work is carried out in accordance with the recommendations and advice of the Research Officers of this Department.

There are now within the area to which the articles refer three thoroughly well established and equipped main Padi Experiment Stations, one at Titi Serong in the Krian district of Perak, one at Pulau Gadong in Malacca and one at Telok Chengai in Kedah, while a fourth has recently been established at Kota Bahru in Kelantan. The main function of these Stations is to provide for all forms of experimental work on the selection, hybridisation, cultivation and manuring of padi.

Their subsidiary functions are the provision of supplies of seed from high yielding strains, the training of Departmental subordinates and the demonstration of proved results to the rice growing community.

The functions of each of the 30 smaller Demonstration Stations and Test Plots are threefold. Firstly to determine by exhaustive comparative trials the two or three pure strains of padi best suited to the local conditions in the area which it serves; secondly, to demonstrate to the local cultivators the increased yields and general superiority of these strains; and thirdly of providing seed supplies. On some of the rather larger Demonstration Stations it is also possible to conduct, as subsidiary lines of work, small scale experiments on certain aspects of manurial and cultivation problems and to utilise these for demonstration purposes.

The first factor to receive attention in the problem of increasing the yield from the existing area of padi land was the plant itself. The method employed was to select high yielding strains from the numerous varieties in cultivation in different parts of the country. This work has already made much progress with the result that there are now a number of such strains suitable for varying conditions of soil, water-supply and climate.

The successive establishment of the four main Experiment Stations has, however, provided increasing facilities for selecting good strains of local varieties under local conditions, with the results that there are still a number of new selections under trial and in certain areas there are indications that better yielding selections are still obtainable.

The next step in progress is to demonstrate the value of these selections and popularise them among the padi cultivators. This is the function of the numerous Demonstration Stations and Test Plots. The object aimed at is the cultivation throughout a given padi area of the fewest possible high yielding strains which will suit the local conditions. There are several advantages to such a procedure, including uniformity of growing period, evenness of ripening, and uniformity of the grain for milling in areas where there is a surplus of padi for sale.

There is now much evidence to show that the longer established Stations and Plots are already serving their purpose, in that large areas around them have been planted with a comparatively few successful selected strains demonstrated on and distributed from each of them.

The second factor in the problem of increasing the yield per acre from the existing planted area is the soil itself. Improvement in soil fertility may be brought about by manuring and also by cultivation.

In relation to manuring, results obtained in the season under review confirm the conclusion drawn by this Department from experiments extending over several years, namely that some condition or conditions exercise a limiting effect on the increase of yield obtainable from the use of manures in areas where crops are normally good. On land from which yields are abnormally low, manures will give a profitable increase in crop, but from average land the increased yield is insufficient to pay for the added cost of manures. The factors exercising this limiting effect are at present under investigation and a considerable programme of research work on this subject is in progress.

The first results of this research work are given in the paper by Mr. J. H. Dennett on pot experiments with padi in which a new method of investigating padi problems is described. The work so far undertaken has been largely of an exploratory nature to investigate the possibility of obtaining yields or responses equivalent to those obtainable under normal field conditions. That such yields and responses are obtained is amply shown in the results recorded. The method described has certain distinct advantages over field work in that it enables very detailed and continuous observations to be made on the plants and soil, while it is cheap and economical of time. Among the disadvantages will be counted the fact that tillering is below that obtained in the field. This may be due to, but is certainly balanced by closer planting as the yields show. For rapid investigation of new possibilities in manuring and methods and rates of application it should prove invaluable, as a few pots only are likely to be sufficient to show the efficacy of any such trial.

There is evidence to show that if the bar to the beneficial effect of manures could be overcome, the result might well be a noteworthy increase in the annual yield of padi per acre in many parts of the Peninsula.

Preparation of the land and methods of cultivation vary considerably in different parts of the country. In so far as they are the outcome of local experience, they may be good. On the other hand they are often laborious and elementary. The indications are that. on the whole, greater uniformity and considerable improvement are possible in these methods. Consequently experiments are in progress to test the effect of different methods, including mechanical cultivation, on the yield of crop. This aspect of yield increase is closely connected with the provision and utilisation of irrigation water which in some localities is in need of improvement and better regulation. The article on dams for small rivers by Mr. B. O. Bush is interesting in this connection.

The work described above has been carried out mainly with "wet" padi, but in Kelantan "dry" padi is a crop of considerable importance, of which the significance to the State and method of cultivation are described in the article by Mr. J. A. Craig. At the Kota Bahru Experiment Station selection, cultivation and manurial experiments are therefore being undertaken with "dry" as well as with "wet" padi.

While the type of plant, cultivation and manuring are all important factors in obtaining increased yields per acre, there remains the further method of growing two crops of padi in one year.

This method has also been investigated, both on a few Test Plots and in certain small padi areas in Selangor and Negri Sembilan. Results so far are inconclusive, because small plots are particularly subject to attacks of birds, rats and other pests when the surrounding land is not under cultivation. Success is, therefore, largely dependent on concerted action by all cultivators in each area. This is shown by the success attending the experiment in a small padi area in Selangor where all the cultivators planted two crops in one year and obtained 480 gatangs per acre of padi from them as compared with an average of 200 gantangs per acre from a single crop in previous years.

It is natural that an Agricultural Department should give attention first to increasing yields from existing areas, but the possibility of extending the planted area has not been overlooked. Since such work involves the provision of drainage and irrigation facilities it has always been conducted in co-operation with the Director of Public Works and more recently with the Adviser of Drainage and Irrigation. The latter has contributed a most interesting account of the activities of his Department during the last two years in developing new areas of padi land and exploring the possibilities of other potential areas for rice cultivation. The more important of the areas in course of development are Sungei Manik in Perak, Panchang Bedena and Tanjong Karang in the Kuala Selangor District and Sungei Blat near Kuantan in Pahang. A drainage scheme for the Tanjong Minyak and Bachang area in Malacca has very recently been

completed. These areas are all fairly adjacent to settled populations which have already taken up a considerable acreage of land in all of them and will probably continue to do so for some time. Other important developments under consideration are discussed in the article. Full development even of the areas where work is now in progress will add materially to rice production in the Peninsula. There remain, however, extensive tracts of country which are gradually being examined, in which rice production seems possible when increase of population provides the cultivators to make use of them.

With improvement in yield and increase in the planted area, it is obvious that surplus production in excess of local needs must be anticipated both in some of the new areas and in certain of the older areas which are now giving an increased production. If facilities for the ready local purchase of surplus padi are not provided, growers are liable to be discouraged and to limit their activities to the production of only sufficient padi to meet their own needs. Since transport of padi is expensive in comparison with that of rice, it is desirable that local mills of comparatively small capacity should be provided in such areas, to act both as buyers of the local crop and distributors of milled rice to surrounding villages, small towns, mines and estates. Such mills have already been erected by private enterprise in the large padi growing areas in Kedah, Province Wellesley and Penang, while the Government Rice Mill at Bagan Serai in Krian is well known. The advantage of a Government owned mill is that it can materially assist in securing a fair price for the grower. The article on Rice Milling by Dr. H. A. Tempany and Dr. H. W. Jack shows the result of recent investigations into this question made by this Department. It discusses the situation that has to be met and the means of meeting it and further indicates that greater attention should be given in local mills to reducing the present high proportion of broken rice, if the local product is to compete successfully with imported rice.

Another article by Dr. H. W. Jack and Mr. R. B. Jagoe discusses the characteristics of locally milled rice in comparison with rice imported from Siam and Burma. It is shown that this local rice contains a high percentage of broken grains derived from mixed padis which contain kernels of unequal size, and that rice grown in Kedah shows more uniformity than rice grown elsewhere in Malaya. It is obviously important that attention should be given to grading in order to raise the quality of rice milled locally.

In connection with milling, storage of the crop is a matter of importance, since working supplies for the mill must be maintained for the twelve months following harvest in any district. In this connection Mr. W. N. Sands has contributed an interesting article on the storage of padi in Kedah.

In preceding paragraphs reference has been made to the use of Padi Test Plots as a means of propaganda in favour of the planting of high yielding types of padi. Another method of propaganda is the institution of Padi Competitions. The Malayan Agri-Horticultural Society has recently co-operated with this

Department in formulating a scheme and rules for an improved Malayan Padi Competition of which a short account is given in the article by Mr. F. W. South.

Towards the end of the number an article on the "World Rice Situation," taken from the International Review of Agriculture, is reproduced. An important point which emerges from this article is that the supply of rice to all countries which do not grow enough for their own needs is mainly derived from three contiguous countries, Burma, Siam and Indo-China.

It is clear in these circumstances that any causes which materially tend to reduce the supplies of rice coming from any or all of these countries is liable to have a severe repercussion on the world's rice situation, inasmuch as it will tend to cause an immediate shortage of rice and consequent distress in countries, such as Malaya, which are dependent thereon, to a marked degree, for their food supplies. Such causes may include unfavourable seasons, civil disturbances or even war.

In the years 1920—1921 this and other rice importing countries experienced a very severe demonstration of the reality of the danger in this connection, while during the Great War it was mainly the fact that the Navy enabled the transport of food to this country to be maintained which averted a similar crisis.

During the rice shortage of 1920—1921 the fact that prices for export staples were maintained at a reasonably high level enabled the situation to be faced with fair success, although, even so, the cost to the country is known to have exceeded $40,000,000 and probably represented a very much larger sum.

If a similar condition of affairs were to arise while the existing depression continues the consequences would be far more disastrous.

In the circumstances, the existing efforts which are being made to foster the production of rice in this country constitute an obvious insurance against an ever present danger.

In the neighbouring territories of the Philippine Islands and the Netherlands India a similar policy has been in force for many years past, with the result that their dependence on imported food supplies has now become reduced to relatively small proportions; if under these conditions a solution has been provided for this pressing and important problem there seems to be grounds for believing that, provided a continuous policy of fostering rice cultivation can be assured, a similar position in Malaya may not be unattainable.

Original Articles.

RICE IN MALAYA IN 1933.

Compiled by
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Chief Field Officer.

In the following article a general survey is given of the position of Malaya in 1933 in relation to both imports and local production of rice. It follows the lines of the section devoted to rice in the Annual Report of the Department of Agriculture, S.S. and F.M.S., for the year 1932 and may be read as an advance section of the Annual Report for 1933.

The average wholesale prices of rice per picul in Singapore to the end of September, 1933, were as follows:—Siam rice No. 2 $3.68, Rangoon rice No. 1 $3.00, Saigon rice No. 1 $3.47, while the retail prices in the three principal ports of Malaya of No. 2 Siam rice were, in cents per gantang—Singapore 26, Penang 27, Malacca 27, as compared with 30, 34 and 28 in 1932.

The price of local padi has varied according to district from 4 to 12 cents per gantang, the higher prices being confined to localities where little or no rice is grown. The average price at mill in Bagan Serai was 6.7 cents per gantang as compared with 7.5 cents per gantang during the previous year.

The net imports of rice into Malaya for the first nine months of the year show that, if imports continue at the same rate for the remaining quarter, the total net imports for 1933 will be some 10,000 tons in excess of the quantity for 1932, though their total value will be some three million dollars less owing to the fall in price. This position accords with the facts that the population of the Peninsula remained about the same as in 1932, since there was no further extensive repatriation of Chinese or Indian labourers, and that the purchasing power of the community increased slightly owing to the low price of rice and the improved prices of the two principal exports, tin and rubber. The following figures show the imports and exports of rice for the last five years:—

TABLE I.

Rice: Malayan Imports and Exports.

Year	Imports		Exports		Net Imports	
	Tons	Value $	Tons	Value $	Tons	Value $
1929	785,558	95,461,036	233,897	28,031,407	551,661	67,429,629
1930	800,443	87,666,723	208,688	23,361,561	591,755	64,305,162
1931	691,112	48,458,102	175,385	13,453,189	515,727	35,004,913
1932	592,145	39,729,242	182,515	12,605,402	409,630	27,123,840
1933 (9 months)	436,686	25,239,137	120,815	7,283,977	315,871	17,955,160

Separate figures showing the imports from the principal producting countries for 1933 are not yet available.

The average declared trade value of imports of rice of all kinds into Malaya for the first three quarters of 1933 was $57.80 per ton as compared with $66.21 and $67.87 in 1932 and 1931 respectively.

Malayan Production.

TABLE II.

Area of Rice Land Planted in Malaya and Yield of Rice.

Year	F.M.S.		S.S.		U.M.S.		Total	
	Area	Production Rice	Area	Production Rice	Area	Production Rice	Area	Production Rice
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
1929—30	174,466	48,727	67,005	25,659	415,727	77,487	657,198	151,873
1930—31	178,930	55,371	67,350	38,837	461,460	164,858	707,740	259,066
1931—32	194,580	66,517	67,980	38,959	462,420	185,489	724,980	287,322*
1932—33	214,160	74,107	70,530	35,000	482,220	182,090	766,910	291,197

(Yield estimated on a basis of 686 gantangs padi = 1 ton rice).

* Amended figure.

The figures for both acreage planted and crop harvested show a further increase on the record established in 1932 and considerably exceed the high figure of 255,000 tons for the crop obtained in 1921 as a result of the rice shortage and the low price of rubber in that year. It is of further interest to note that in the period of 3 seasons since the season 1929—30, that is the period during which the rapid fall in the price of rubber occurred, the area planted with padi in Malaya has increased by approximately 110,000 acres and the production of rice has very nearly been doubled. The increase in crop is proportionately much greater than the increase in the planted area. This is attributable in part to favourable weather conditions, but in part also to more thorough cultivation, the much wider use of pure strain seed, and greater attention to the control of pests, especially rats.

Weather conditions in the season 1932—33 were again favourable in many areas, though in others they were not so good as in the previous season. As a result the average yield of wet padi per acre in Malaya was 276 gantangs as compared with 297 gantangs per acre in 1932, though the yield of dry padi at 146 gantangs per acre showed a further improvement on the crop of 139 gantangs per acre in the previous year.

The Federated Malay States area planted increased by 19,580 acres to a total of 214,160 acres and produced a crop of 50 million gantangs of padi, over 5½ millions greater than in the previous year. These figures do not, however,

YIELDS OF PADI IN MALAYA 1922—33

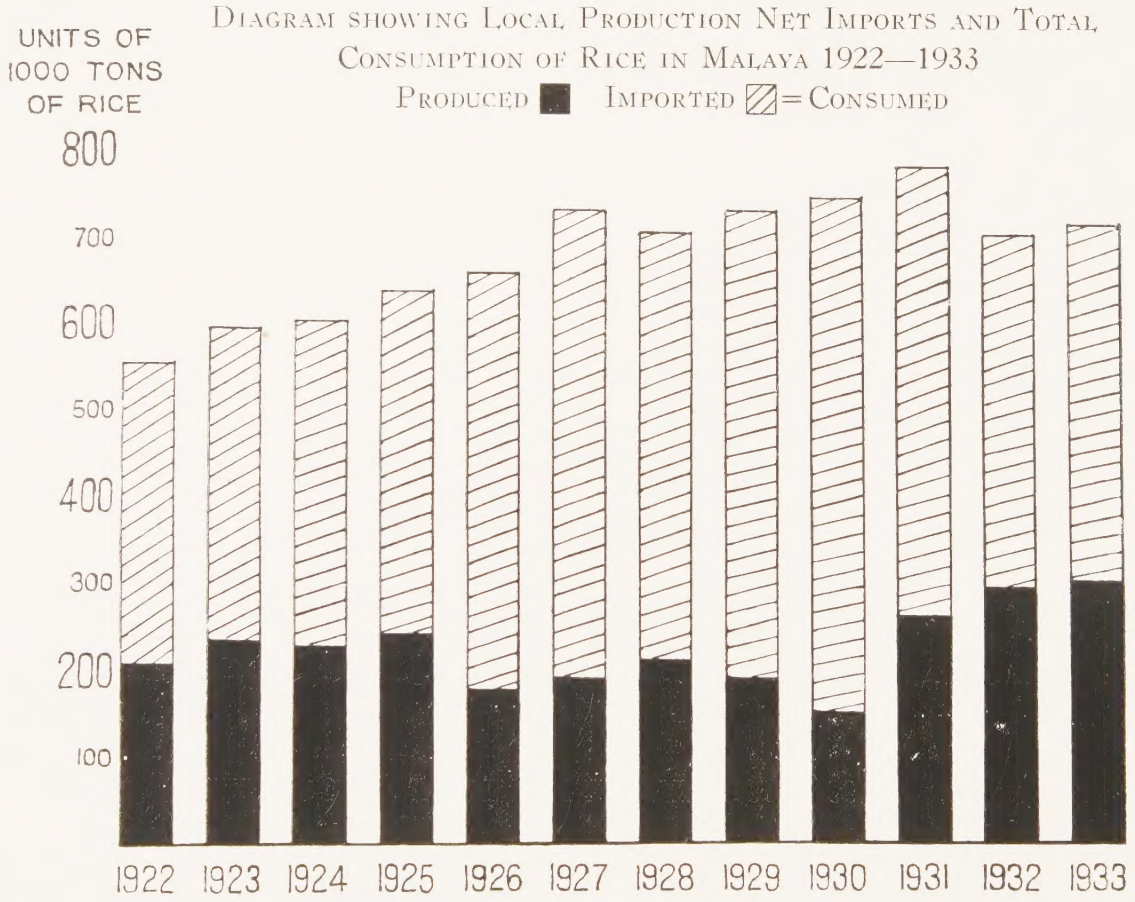
Diagram showing Local Production Net Imports and Total Consumption of Rice in Malaya 1922—1933
Produced ■ Imported ▨ = Consumed
UNITS OF 1000 TONS OF RICE
800
700
600
500
400
300
200
100
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933

take into account a careful revision of the area of padi land in the Krian district of Perak which was reduced by 2,806 acres as compared with that given for 1932, to allow for the land occupied by dry crops and house sites which had previously been included in the total area planted. The agreed estimate of the crop in 1933 was 1,764,102 gantangs below that of 1932. It is considered that actually the area planted was the same in both years and that the crop of 1933 was at least as good as that of 1932, so that the real increase in the area planted and crop reaped in 1933 over those of 1932 should be approximately 22,400 acres and 7½ million gantangs respectively. The increased yield was mainly due to the increase in the planted area. The yield of wet padi per acre in the Federated Malay States was 251 gantangs as compared with 245 gantangs in the previous season and dry padi gave 139 gantangs per acre against 122 gantangs in 1932.

The area planted in the Straits Settlements increased by 2,550 acres, whilst yield decreased by 2,381,000 gantangs, mainly owing to drought early in the season in Province Wellesley North and the coastal padi lands in Malacca. Also owing to drought the wet padi crop in the Dindings was almost a complete failure.

The Unfederated Malay States showed a decrease in crop of 738,000 gantangs as compared with that of the previous season, whilst the area of land under padi increased by 19,800 acres. Gains in crop of some 4,350,000 gantangs in Kedah and Johore were offset by decreases totalling about 5,100,000 gantangs in Perlis, Kelantan and Trengganu, the biggest decrease being 3,100,000 gantangs in Trengganu which also showed a decrease of some 7,400 acres in planted area. The area of land planted with wet padi again showed an increase of approximately 25,000 acres to a total of 418,200 acres, while the dry padi area showed a further decrease of about 5,000 acres to 64,010 acres. The yield per acre of wet padi for this season was 276 gantangs per acre and of dry padi 147 gantangs per acre as compared with 294 gantangs and 144 gantangs respectively in the season 1931—32.

TABLE III.

Malayan Production of Rice in Relation to Net Imports and Consumption, 1929-1933.

	1929	1930	1931	1932	1933
Net Imports	551,661	591,755	515,727	409,630	420,000 (Estimated)
Production (tons)	184,008	151,873	259,066	287,322	291,197
Consumption (tons)	735,669	743,628	774,793	696,952	711,197 (Estimated)
Percentage of production to net imports	34	26	50	71	70
Percentage of production to consumption	25	21	33	42	41
Percentage of 1930 net imports replaced by increased production	5.5	0	18.1	22.9	23.5

TABLE IV.

Areas and Yields of Padi for the Following Years.

Area	Total Yield Padi		Yield per Acre
1922	644,200	140,727,000	218
1923	657,380	156,411,000	238
1924	651,930	149,152,000	229
1925	656,080	159,135,000	243
1926	653,900	120,001,000	184
1927	649,690	128,374,000	198
1928	663,070	135,127,000	204
1929	687,060	126,229,000	184
1930	657,200	106,784,000	162
1931	707,740	175,867,000	248
1932	724,980	197,103,000	272
1933	766,910	199,761,000	260

TABLE V.

Area of Land Planted in Malaya and Yields of Padi, 1932-1933.

State or Territory	Wet		Dry		Total	
	Acres	Gantangs	Acres	Gantangs	Acres	Gantangs
Perak	88,620	24,330,000	18,350	2,927,000	106,970	27,257,000
Selangor	25,010	4,936,000	3,800	412,000	28,810	5,348,000
Negri Sembilan	33,930	9,948,000	460	52,000	34,390	10,000,000
Pahang	36,690	7,876,000	4,300	356,000	43,990	8,232,000
Total F.M.S.	187,250	47,090,000	26,910	3,747,000	214,160	50,837,000
Province Wellesley	32,930	10,667,000	810	195,000	33,740	10,862,000
Dindings	250	27,000	260	28,000	510	55,000
Malacca	31,940	10,925,000	—	—	31,940	10,925,000
Penang	4,340	2,168,000	—	—	4,340	2,168,000
Total S.S.	69,460	23,787,000	1,070	223,000	70,530	24,010,000
Johore	15,800	2,091,000	9,260	909,000	25,060	3,000,000
Kedah	219,010	74,366,000	6,060	1,136,000	225,070	75,502,000
Perlis	41,600	10,798,000	—	—	41,600	10,798,000
Kelantan	110,120	24,429,000	37,210	5,822,000	147,330	30,251,000
Trengganu	31,680	3,784,000	11,480	1,579,000	43,160	5,363,000
Total U.M.S.	418,210	115,468,000	64,010	9,446,000	482,220	129,914,000
Total Malaya	674,920	186,345,000	91,990	13,416,000	766,910	199,761,000

Note: Acreage to the nearest 10 acres.
Yield to the nearest 1,000 gantangs.

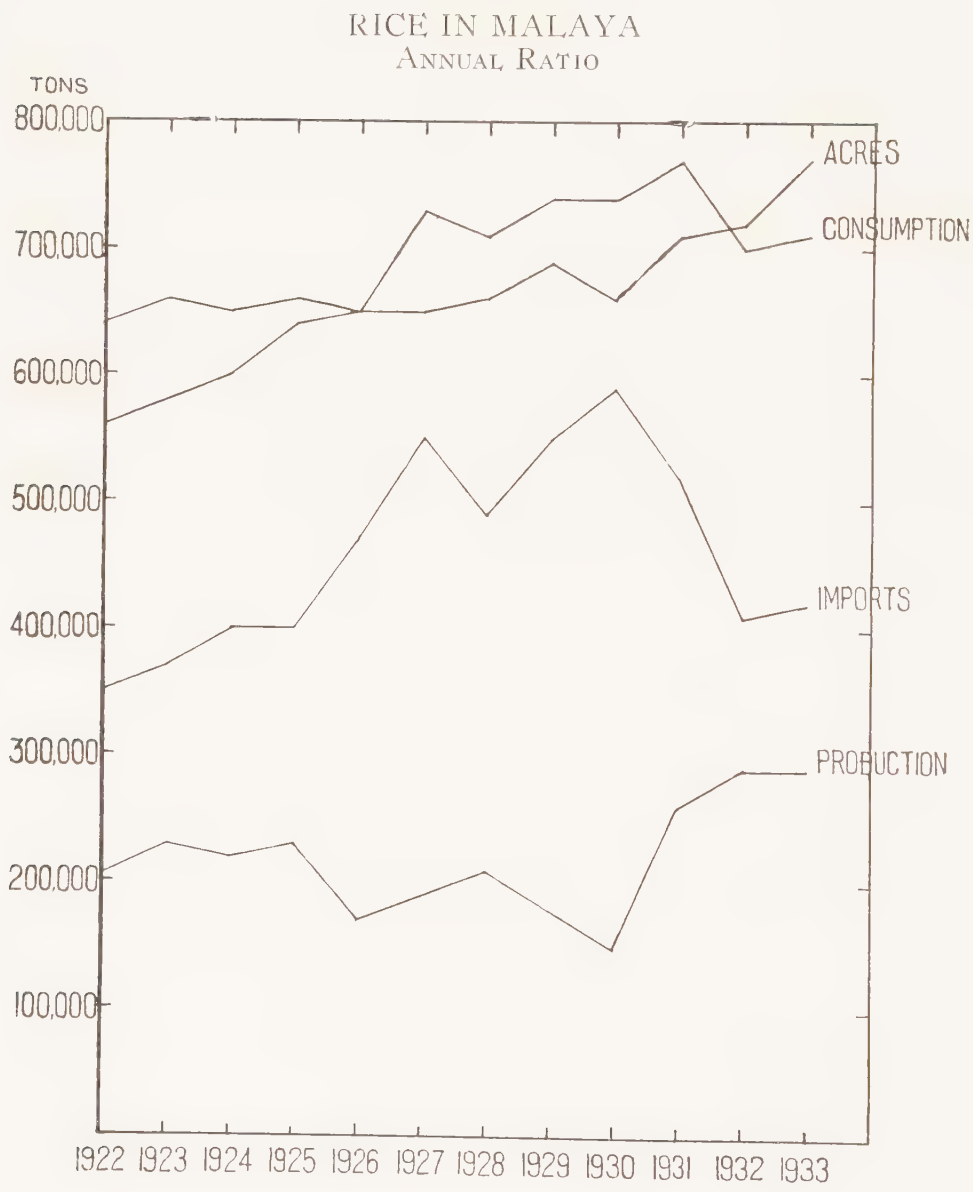
RICE IN MALAYA
ANNUAL RATIO
TONS
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
ACRES
CONSUMPTION
IMPORTS
PRODUCTION
1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933

Table III above and the diagram show clearly that the decrease in imports during the last three years is due only in part to the cause previously mentioned, namely, repatriation of Indian and Chinese labourers from mines and estates.

An increasingly greater portion of this decrease is due to the replacement of imports by local production. Thus in 1933, while estimated imports will have declined by approximately 172,000 tons as compared with those in 1930, when they were highest, consumption declined by only about 32,000 tons, leaving about 140,000 tons to be provided by increased production.

Graphs showing planted acreage, production, imports and consumption of rice in Malaya during the period 1922 to 1933 inclusive, this being the period for which the figures are fairly reliable, are included in this article. It will be seen that for the 9 years 1922 to 1930 inclusive, the average local production of rice remained practically constant at 200,000 tons per annum, variations being only such as were due to annual differences in weather conditions during the padi season. This is true even of the low production in 1930 which was a year of exceptionally unfavourable weather and consequent poor harvests in Kelantan, Kedah, Province Wellesley and Krian.

Production during the last three years 1931 to 1933 has, however, shown a rapid rise to an average of 278,000 tons, the increase of 78,000 tons having replaced a like amount of imports. Although weather conditions during these years were favourable, this factor alone does not explain all the increase in production. The graph shows that there was an average increase of 85,000 acres in the planted area during these three years as compared with the average of 647,000 acres planted during the previous 9 years, while average production during the past three years was considerably higher than that of 1925 which was the highest in the preceding 9 year period.

Reference to Table IV above and to the graph giving the yields per acre during the same period, shows that in the last three years the average yield per acre has been 260 gantangs as compared with the previous highest figure of 243 gantangs in 1925. It would seem, therefore, that the rise in the yield per acre during the last three years is not attributable only to weather conditions, but is partly due to other factors such as improved cultivation and the wider use of high-yielding, pure strains of padi.

Consequently, increased production is apparently due both to an increase in the planted area and to an increased yield per acre which is only in part the result of favourable weather conditions, the balance being due to factors which would operate even in a bad season.

Crop of 1932-33.

In Krian, although damage to the spillway and drought delayed planting in the fertile, north western portion, the south eastern portion was planted up to schedule. Later in the season conditions improved and with good dry weather at harvest a good crop was obtained.

In the remainder of Perak, the inland districts of Selangor and Pahang and the whole State of Negri Sembilan good crops were reaped.

In the coastal districts of Selangor the planted area was increased by 2,493 acres owing to the opening up of new padi areas in Kuala Selangor district. The yield obtained was, however, low, since the harvest was prolonged and much damage was caused by rats and stem-borers, as is to be expected in the first few seasons on land newly cleared from jungle.

In the Pekan district of Pahang a minor flood occurred during March, shortly after transplanting. In consequence supplies of padi seeds of early maturing strains to the amount of 10,221 gantangs were obtained from Malacca and other sources and distributed. Part only of this seed was of pure strains of padi, as the supply was insufficient to meet the demand, but the balance was known to be of good quality. For the State as a whole the season proved satisfactory, since increases in planted area and crop amounting to some 9,000 acres and 2,300,000 gantangs respectively were recorded.

The yield in the Raub district of Pahang was just over 300 gantangs per acre. Yields in this district have increased by 100 gantangs per acre or 33 per cent. during a period which has coincided with the distribution of a few proved pure strains of padi from the Dong Padi Test Plot.

In the northern half of Province Wellesley drought up to the end of August adverseley affected the ultimate yields. In November heavy floods were experienced in both Province Wellesley and Penang, the padi crop, however, suffered comparatively little damage.

In Malacca the coastal areas suffered from drought early in the season, but elsewhere the crop was satisfactory.

In Kedah the planted area at 225,070 acres and the crop of 75,502,000 gantangs are both believed to be the highest ever recorded for this State. This is all the more satisfactory since the area planted with wet padi was responsible for the whole increase, there being a reduction in the area planted with dry padi. The yields of both wet and dry padi per acre were high being estimated respectively at 340 and 187 gantangs per acre.

In Johore there was a satisfactory increase of some 5,000 acres in the planted area, mostly in extensions of existing areas. The crop showed an increase of somewhat over one million gantangs, but the yields per acre were comparatively low. This is probably due to the irregularity of planting dates in the State, in consequence of which a heavy toll of the crop is taken by birds and other pests.

Double Cropping.

The final result of the attempt to produce two crops in one year in the small area at Rasa in Ulu Selangor district was encouraging. The first crop planted in February gave a yield of 200 gantangs per acre in July 1932. The second crop planted in September 1932 gave a yield of 280 gantangs per acre in February 1933. Consequently the total crop of padi for the year was 480

gantangs per acre as compared with an average yield of 200 gantangs per acre in previous years. The general conclusion reached from the results obtained throughout the State is that double cropping is possible in certain areas under favourable conditions. Furthermore, it can be safely stated that, in the inland districts of Selangor, padi grows as well during the short as during the long wet season, provided that planting is so arranged that flowering does not take place in very dry weather.

A similar attempt to grow two crops in a year was made over an area of approximately 100 acres at Sri Menanti in the Kuala Pilah district of the Negri Sembilan. The land was cleared immediately after the harvest in March and planted with Radin Siak, normally a short term padi. Subsequent work on the weeding and irrigation of this crop was, however, neglected, with the result that growth was poor and much damage was sustained from the attacks of stem-borers and rats as well as of birds at harvest. The yield obtained was in consequence negligible and the whole experiment inconclusive.

Crop planted in 1933 for reaping in 1934

In Kedah, Province Wellesley, Penang and Krian, weather conditions during the present season have been on the whole favourable and good crops are expected if the weather remains normal. Prospects are also good in Malacca though drought delayed planting in the coastal padi lands. Drought also delayed planting in the riverine areas in Upper Perak and Kuala Kangsar districts of Perak, it is, however, as yet uncertain to what extent yields will be affected, since any check due to late planting may be counteracted by the more careful attention given to weeding and other cultural details.

In the Negri Sembilan and Johore crop prospects are satisfactory. In the former State rat control has not received adequate attention, while it is difficult to forecast the effect of a harvest during the wet months of November and December in Jelebu district, or the potential dangers of a long wet season and late harvest to the late planted crop in Kuala Pilah district. In Johore planting dates were again very irregular, so that part of the crop was being reaped when other areas were being planted. It is believed that the planted area has again been extended.

In Pahang the prospects for an average harvest are good, but drought has rendered planting late in some of the riverine mukims, so that the ever present danger of loss from floods has to be considered. The drought has also reduced the plantable area of most of the saucer-shaped padi fields bordering the Pahang river, with a consequent decrease in the planted acreage in this portion of the State. This decrease may, however, be offset by additions elsewhere.

In Kelantan unusually dry weather during the period July to October delayed planting and will quite possibly considerably reduce the yields of both the wet and dry padi crops.

In the inland districts of Selangor two sets of planting dates were arranged, one for double cropping and the other for a single crop to be harvested in January and February 1934.

The earlier planting dates were adopted over a considerable area, planting being commenced in March and the harvest reaped in September and October; strains of padi of short maturation period were grown. The most popular of these padis were two local varieties Acheh and Kelantan and the pure strains Nachin 27 and Radin Siak. Growth was good and satisfactory yields were obtained. Unfortunately, owing to the incidence of the Mohamedan fasting month it was not possible to plant a second crop without again placing the planting season in the wrong period of the year. The long term padis planted in other areas during August have on the whole made good growth.

In Kuala Selangor district padi planting was delayed by dry weather, but transplanting was completed by the end of November since when the young plants have made good growth. Development of the Panchang Bedena area in this district has progressed. Work on the drainage scheme has been actively continued by the Drainage and Irrigation Department and a further 150 acres of jungle have been felled and prepared for planting.

Further progress has also been made with the drainage and irrigation schemes in the Sungei Manik area in Perak and the Sungei Blat area in Kuantan district of Pahang.

During the season some 8,500 gantangs of seed of pure strains of padi were distributed from the various Padi Experiment Stations and Test Plots throughout Malaya.

During the present season a new Padi Test Plot has been opened in the Sungei Blat area of Kuantan district in Pahang and two more Padi Test Plots have been planted in Johore, one at Ayer Pupan in Endau district and one close to Segamat. Moreover the padi area in the combined Agricultural Station and Padi Test Plot at Kilanas and the Padi Test Plot at Lumapas in Brunei have also been cleared and planted.

Pests.

During the present season pests have been little in evidence. Vigorous control measures have prevented the recurrence of serious damage by rats in the newly planted Panchang Bedena padi area. In the Negri Sembilan rat destruction has not been given adequate attention by padi growers and in Johore where there is much cover near padi fields rat damage is as usual considerable.

In Krian, Province Wellesley and Malacca the systematic control measures organised under Departmental supervision have continued to prove effective and damage to nurseries or the growing crop by rats has been negligible.

PADI EXPERIMENTS IN MALAYA 1932-1933.

Selection and Varietal Trials.

BY

H. W. JACK,

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Introduction.

The padi season 1932-33 was a good one generally throughout Malaya and weather conditions being favourable, pests caused rather less damage than is usual in the main padi area. The depressed condition of the rubber industry stimulated padi planting while special efforts on the part of Agricultural and District Officers also met with considerable success.

Under existing industrial conditions padi cultivation is likely to show further advances and considerable assistance in this direction is now being given by the Department of Drainage and Irrigation with regard to water control schemes in various suitable areas. The experiments which are summarised in this paper indicate advances which have been made in investigations connected with this very important crop and they should be regarded as a continuation of similar reports published in December 1931 and 1932 in this Journal.

It must be mentioned that, although most of the experiments were devised by the Research Staff of the Department of Agriculture at Kuala Lumpur, the practical work was carried out by the Agricultural Field Officers who control the Experiment Stations and Test Plots in the various States and Settlements and to them full credit is due.

The reports of the investigations undertaken in the Unfederated Malay States are included by the courtesy of the various Governments concerned and add considerably to the value of this article.

The aim in padi selection experiments is the isolation of padi types suitable for giving the highest possible returns of grain per acre under the different environmental conditions under which padi is grown in Malaya. As a result of experience, and of definite experimental trials, it has been found that no one variety of padi is adequate for all districts but suitable selections have now been found for many areas. For the soft heavy clay areas which are abundantly supplied with water, one of the six best Seraup (Nos. 1, 15, 36, 48, 68 and 371) long maturation strains is usually found to be the most prolific. In loams and lighter soils the choice lies between Radin, Nachin and Siam types, all approximately of 6 months' maturation period. The best Radins are Nos. 2 and 4 and, in a few areas, Radin No. 7, while Nachin 10, Nachin 66 and Siam 29 have lately proved very prolific in these soils though, compared with the Seraups, especially Nachin 10, the straw is lacking in strength, and they are, in

consequence, liable to lodge in wet harvests such as are experienced from to time in certain areas. The Seraup types, which are of excellent milling quality, originated in the Krian district of Perak and form the bulk of the crop from the northern section of that district in a normal year. In a late season in the same area Radin types are likely to predominate and they are more popular, generally, for eating than the Seraup types. All the Seraup and Radin selections have characteristically stout straw—a necessity in north Krian where the harvest is frequently marred by rains, especially if harvesting is late. The Nachin and Siam types originated in Malacca, where seed selection was inaugurated at Pulau Gadong Experiment Station with these local, popular varieties in 1925, by which time it had been ascertained, by experiment, that the Radin and other Titi Serong selections did not suit the padi growing conditions of Malacca—an important rural area.

The above mentioned selections were made by the Division of Economic Botany, the Agricultural Field Officer, Malacca, (J. Fairweather from 1921 to July 1928 and C. L. Newman from July 1928) being responsible for the field work at Pulau Gadong Station where the Siam and Nachin strains were isolated between 1925 and 1928 as potentially useful selections based on ear-to-row characteristics and mean crop-weights per plant. These selections were later confirmed by "chess board" plot tests and the latest results indicate that these strains have justified their selection. Siam 29, in particular, would appear not only to suit padi growing conditions in Malacca but in a number of other areas as well, as evidenced by results at Padi Test Plots which are now organised in most of the main padi areas. Nachin 10, while it is a good yielder in areas where dry harvest weather is the rule, will not stand up to wet harvest conditions but, in time, it is hoped that this defect may be remedied by combining its high yielding ability with strength of straw by hybridisation or by substituting Nachin 66 wherever it may be found suitable, since it has stronger straw than Nachin 10 and yields equally good crops.

During the past season the testing of various selections has, in principle, been fairly uniformly accomplished in 1/40 acre plots in randomised blocks replicated six times in the Experiment Stations and Test Plots now distributed over padi areas more or less representative of the whole of Malaya, though in a few cases the details of lay-out varied in regard to size of plots, number of strains tested and the number of replications of the blocks. The results at the various Experiment Stations and Test Plots are summarised below, yields being given in lbs. while percentages are shown to the nearest whole number.

Titi Serong Experiment Station, Krian, Perak.

Planting operations were delayed in this area by drought which was prolonged to the last week of September so that seedlings, especially the Seraups, were kept too long in the nurseries while, after the final transplanting, deep water adversely affected the young padi, particularly the early maturing strains.

Twelve late and ten early maturing strains were compared indepently in adjacent blocks in the same 'bendang' so that the mean yields of all the 22 plots are comparable.

The size of the plots in this area was 1/109 acre as usual and 84 replications adopted. The mean yields of the heavy and light types* respectively were 2370 lbs. and 1970 lbs. Both figures are low for the area, largely because grain was lost by over-ripeness, since many of the strains were too long in the field before reaping. The same types gave approximately 15 per cent. more grain in adjacent multiplication plots which were sown on the same day but reaped several days earlier. For instance, Seraup 36 gave an average yield of 2320 lbs. per acre in the trials whereas in 3 adjacent multiplication plots, this strain, sown on the same day but reaped 8 days earlier, gave an average yield of 2770 lbs. per acre. Similarly Radin 2 in the test plots, and in adjacent multiplication plots, gave yields of 1800 lbs. and 2080 lbs. respectively but the crop in the latter instance was reaped 7 days earlier than in the test plots. Seraup 36 and Radin 2 normally ripen 6 to 10 days earlier than the other strains of the same varieties, and both shatter more readily than most of the other strains so that they lose more grain in proportion, and hence they are both placed low in the tests in their respective classes in the last season. This emphasises the necessity of reaping the padi when it has reached its optimum stage of ripeness and also the need for repetition of tests, over several seasons, before final conclusions can be formed. The weather at harvest was good and rats and stem-borers did practically no damage. As regards the heavier types under trial, the tabulated results (Table I) of the season show a low standard deviation and a significant difference of 10.1 per cent. so that Seraup 68 and Seraup 48 are definitely superior to Radin 4 and those lower in the scale. Radin 4 and Radin 7, on the season's results show better returns than Seraup 36 which is further evidence of the loss of grain which this strain must have sustained by over-ripeness since, over a long period, Seraup 36 has always given superior yields to these Radin strains.

Amongst the earlier maturing strains Radin 13 shows signficant superiority over the Radin mixture and those of lesser yield, while Siam 29 is superior to Radin 16 and those below it in order of merit. Radin 2 gave low yields in this season, probably on account of its over-ripeness as already mentioned. In the same Table the best strains of both the long and the early maturing types are compared and it is shewn that Seraup 68 and Seraup 48 are superior to Seraup 1 and those of lesser yield. Seraup 36 and Radin 2 are low in order of merit and Siam 29 lodges too easily for this area but appears to be improving with acclimatisation in the past three seasons.

* Light types normally mature in less than 6½ months.

Heavy types normally require more than 6½ months to mature.

Kuala Kurau Test Plot, Krian, Perak.

At this Test Plot 9 selections were tested against a local variety in 1/40 acre plots randomised in 6 blocks and a summary of results is included in Table 1. The Agricultural Field Officer, Krian, found that the control variety was Seraup 15 which has been grown widely in this vicinity for some years. The plants were rather a long time in the nurseries and, after transplanting into the fields, deep water somewhat retarded growth and tillering. Nachin 756 (F. 756) flowered earlier than the other varieties and much grain was lost due to the ravages of birds while all the plots of Siam 29 and Nachin 10 were lodged at harvest. With a significant difference of 18 per cent. Seraup 48, Seraup 36 and the control type (Seraup 15) have shown definite superiority over Nachin 10 and those below it in order of yield.

Radin 4 and Radin 2 yielded heavier crops than Nachin 10, Siam 29 and Mayang ebos 203 but not to the degree of significance though they showed definite spueriority over Nachin 756 and Serendah 824, which are earlier ripening types. The results show that the long maturation types yield best in this area but good crops should be derived from Nachin 10 and Siam 29, if their straws can be strengthened by hybridization (this is under investigation). F. 756 and F. 824 are promising in years of shortage of water as they crop well and ripen early and are popular for eating, particularly the latter, and on previous experience they have been found to yield better than the local Padi Acheh which has been fairly widely used in late seasons during the past 5—6 years. Much of the padi grown in the neighbourhood of this Test Plot has been derived from previous distributions of Seraup 15 and Seraup 36 and to a lesser extent of Seraup 48, R. 4 and R. 2. In the past season Seraup 48 with a calculated mean yield per acre of 2,800 lbs. gave better but not significantly better yields than the other Seraups. The mean calculated yield for all strains was 2,212 lbs. per acre.

Selinsing Test Plot, Krian, Perak.

At this area 8 selections were compared with a local popular type in 1/40th acre plots replicated six times in randomised blocks. One selection, F. 10 (Radin Siak) was badly mixed in planting and has, in consequence, been omitted from the calculations which are summarised in Table 1. The Agricultural Field Officer ascertained that the control was Radin 11 derived from previous distribution in this area. Certain unforseen difficulties which were experienced early in the season, tended to reduce the value of the trials to some extent. The summary shows that Nachin 10 and Siam 29 are significantly better than the control (Radin 11) while Nachin 10 is definitely superior to Siam 29 and Radin 2. During the past 3—4 seasons Radin 2 has given good crops and has spread in this neighbourhood and might usefully be included in further trials before finally reaching conclusions as to its merits. The mean calculated yield in this area was 1890 lbs. per acre.

TABLE I.

Krian District of Perak.

Locality	Variety	S. 68	S. 48	R. 7	R. 4	S. Mix	S. 371	S. 0	S. 1	S. 36	S. 20	S. 146	S. 15	G.M.	S.D.	S. Diff
Titi Serong (late types)	Mean	24.8	24.7	23.0	22.5	22.5	22.3	21.3	21.2	21.0	20.2	19.2	18.9	21.8	.70	2.2
	% of G.M.	114	113	105	103	103	102	98	97	96	93	88	87	100	3.2	10
	Variety	R. 13	Sm. 29	N. 10	F. 824	R. Mix	R. 16	F. 756	R. 2	F. 27	F. 875	G.M.	S.D.	S. Diff		
Titi Serong (early types)	Mean	22.3	21.0	20.2	20.0	19.7	17.2	17.0	16.5	16.2	14.7	18.08	.86	2.72		
	% of G.M.	123	116	112	110	108	95	94	91	90	81	100	4.7	15		
	Variety	S. 68	S. 48	R. 7	R. 4	R. 13	S. 371	S. 1	S. 36	Sm. 29	S. 15	R. 2	G.Mean	S.D.	S. Diff	
Titi Serong (early & late)	Mean	24.8	24.7	23.0	22.5	22.3	22.3	21.2	21.0	21.0	18.9	16.5	21.7	.83	2.6	
	% of G.M.	114	114	106	104	103	103	97	97	97	88	76	100	3.8	12	
	Variety	S. 48	S. 36	C	R. 4	R. 2	N. 10	Sm. 29	F. 203	F. 756	F. 824	G.Mean	S.D.	S. Diff		
Kuala Kurau	Mean	70.0	64.2	63.0	59.2	55.2	52.8	50.5	49.3	45.7	43.3	55.3	3.27	10.32		
	% of G.M.	127	116	114	107	100	95	91	89	82	78	100	6	18		
	Variety	N. 10	Sm. 29	R. 2	C	F. 824	F. 8	R. 4	N. 27	G.M.	S.D.	S. Diff				
Selinsing	Mean	59.2	51.8	47.2	47.0	46.7	44.7	42.3	38.7	47.2	2.21	4.92				
	% of G.M.	125	110	100	99	99	95	90	82	100	5	10				
	Variety	Sm. 29	F. 203	F. 824	N. 10	R. 2	C	S. 48	R. 4	N. 27	F. 10	G.M.	S.D.	S. Diff		
Briah	Mean	65.7	58.2	53.1	52.3	52.1	50.8	47.8	45.3	30.2	29.6	48.5	1.96	5.94		
	% of G.M.	135	120	109	108	107	105	99	93	62	60	100	4	12		

Briah Test Plot, Krian, Perak.

A local popular type was tested against 9 selected strains at this Test Plot in 1/40 acre plots replicated 9 times in randomised blocks. The Agricultural Field Officer, Krian, discovered that the control type was Serendah 875 derived from previous distributions of padi seed in this area. A summary of the results is shown in Table I. One plot of Siam 29 which was situated on a previous house site, gave a yield of 99 lbs. which had the effect of raising the average yield per plot for this strain by 4 lbs., thus rather exaggerating its productive capacity and making it appear significantly superior to all other varieties in the comparison. However, even with a corrected yield of 128 per cent. (compared with the mean yield) it is superior to all but Mayang ebos 203 which is itself superior to the control type. Several ant hills had to be removed from this area and Radin Siak 10 was unfortunate in being planted in most of the plots which had to be treated in this respect, with a consequent diminution in its plot yields, moreover this selection and Nachin 27 ripened earlier than the other, were somewhat over-ripe and were detrimentally affected by birds. The yields are good for this area, the mean calculated crop being 1940 lbs. of clean padi.

Lenggong Test Station, Lenggong, Perak.

Several plots in this Station suffered from floods which were experienced four times and were most severe in the Seraup plots causing a fair amount of lodging amongst these strains. The early maturing types, although they were not so fully exposed to the floods, suffered more severely therefrom. However, despite the floods, and slight damage by birds and sucking bugs, good crops were reaped on this area, the calculated general mean yield for Seraup being 3780 lbs. per acre and for the lighter types 3390 lbs. The good growth conditions necessitated two weedings of the early planted Seraups and it is noticeable that all these types ripened within a period of 7½ months from the date of sowing. Three Seraup selections were compared with a local Seraup type in 1/40 acre plots replicated 10 times in randomised blocks, while six early maturing types were tested against a local Radin variety in plots of similar size replicated 6 times in randomised blocks. The results are given in Table II which shows that Seraup 36 is significantly better than the local Seraup, while Seraup 15 and Seraup 1 gave higher yields than the control but not to the degree of significance. This result confirms the trials of the previous two seasons and there is no doubt regarding the yielding ability of Seraup 36 and Seraup 15 in this locality, while Seraup 1 has also given useful yields each season compared with the local varieties. Of the earlier ripening types Mayang ebos Nos. 202 and 208 and Siam 29 gave significantly heavier yields than the local Radin variety which was also considerably exceeded in yield by Radin 2 and Radin 4 though not to a significant extent. As far as R. 2, R. 4 and Siam 29 are concerned this result

confirms those of the previous 2 years, while Mayang ebos 202 and 208 are distinctly promising in their first test at this area, with yields little short of Seraup 36.

Nachin 10, though potentially a heavy yielder, failed owing to its weak straw and should be eliminated.

Talang Test Station, Kuala Kangsar, Perak.

The weather conditions appear to have been good in this area in the past season, as the general mean yield from the varietal trials was 3130 lbs. per acre, despite slight attacks of stem-borers and grain sucking bugs. Nine selections were tested against a local Radin type in randomised 1/40 acre plots quadruplicated in blocks; a summary of the results is included in Table II in which it is apparent that the local Radin type failed signally in comparison with all the selections. The significant difference between means is high but still Siam 29 gave excellent and significantly better crops than Radin 2 and those of lesser yield. Nachin 756 and Serendah 824 gave surprising yields in comparison with Radin 2, which over several years has given the best yields, and with Radin 4 which gave the highest yield in 1930—1931 and was little behind Radin 2 in the 1931—1932 season. This result, coupled with the low yields of Radin 4 and Radin 2, indicates that the season may have been abnormal in some respect and, therefore, too much reliance should not be placed on the results for the present. Siam 29 certainly appears to be very prolific and promising in the locality, while Nachin 756 may be useful for its early maturity and good straw, its calculated mean yield per acre being 3720 lbs.

Bukit Gantang Test Plot, Perak.

This area suffered from water shortage on three occasions during the growing period of the padi, owing to the collapse of the dam, while rats caused slight damage in patches, nevertheless the general average yield of 2472 lbs. per acre was quite good. Eight selections were tested against a local Radin type in 1/40 acre plots quadruplicated in randomised blocks and a summary of the results is included in Table II. The best crops were derived from Radin Nos. 7, 2 and 4 and Nachin 22 but, although the yields of these strains were considerably better than that of the control, no significance was portrayed in the results. The vagaries of the water supply undoubtedly rendered the results unreliable in the past season and caused a fair amount of lodging, Nachin 22 being the worst in this respect. Nachin 27 stood up excellently but as it ripened earlier than any of the other selections it probably suffered more from the water shortage which occurred just before flowering. The inclusion of a few types with stronger straw appears to be indicated in this area in further trials, care being taken to plant the various lots so as to synchronise harvesting dates as nearly as possible.

TABLE II.

Perak (Excluding Krian District).

Locality	Varieties	F. 202	F. 208	S.M.29	R. 2	R. 4	Cont.	N. 10	G.M.	S.D.	S. Diff.				
Lenggong (early)	Mean	95.2	94.8	91.0	88.8	86.0	73.5	64.0	84.7	5.4	16.9				
	% of G.M.	112	112	107	105	102	87	76	100	6.4	19.9				
	Variety	S. 36	S. 15	S. 1	Local	G.M.	S.D.	S. Diff.							
Lenggong (late)	Mean	110.5	92.7	90.0	84.1	94.57	6.7	19.8							
	% of G.M.	117	98	95	89	100	7.1	21							
	Varieties	S.M.29	F. 756	F. 824	N. 10	R. 2	R. 13	F. 202	F. 208	R. 4	Cont.	G.M.	S.D.	S. Diff.	
Talang	Mean	102.7	93.2	83.7	82	80.5	80.0	78.5	75.0	63.8	43.7	78.3	6.04	20.8	
	% of G.M.	131	119	107	105	103	102	100	96	81	56	100	7.7	26.5	
	Variety	R. 7	R. 2	R. 4	N. 22	F. 741	Cont.	P. 1	R. 13	N. 27	G.M.	S.D.	S. Diff.		
Bukit Gantang	Mean	68.2	68.0	66	64.5	63.2	60.2	59.5	55.2	52.0	61.8	3.5	12.1		
	% of G.M.	110	110	107	104	102	97	96	90	84	100	5.7	19.5		
	Variety	S. 1	S. 15	S. 36	R. Loc.	R. 2	R. 13	S. Loc.	F. 201	F. 741	R. 4	F. 27	G.M.	S.D.	S. Diff.
Bruas	Mean	73.6	71.5	68.0	63.6	61.2	58.2	57.5	55.5	51.5	44.3	37.0	58.3	4.8	15.1
	% of G.M.	126	123	117	109	105	100	99	95	8	79	64	100	8.2	26.0

Bruas Test Plot, Kuala Kangsar, Perak.

This area suffered from its newness as many of the plots were uneven, resulting in different water levels within many of the plots so that the padi ripended unevenly. In addition, several plots were so severely affected by the presence of holes and tree stumps as to influence the results materially. This defect applied particularly to Radin 4 and Nachin 27 since, with each of these strains, 3 plots produced only about half of their potential yields which, in the case of R. 4, reduced the average yield for the variety from a potential value of 65—70 lbs. to 44 lbs. per plot, while, with Nachin 27, the potential value was reduced from 50—55 lbs. to 36.5 lbs. Seraup 36 was similarly affected but not so materially as R. 4 and N. 27. The results summarised in Table II, show too high a standard deviation, but Seraup 1 produced a signicantly better crop than the local Seraup control while Seraup 15 and Seraup 36 gave considerably heavier crops than the control but not to a significant degree. The local Radin control, which on examination appeared to be Radn 13 acclimatised from previous distributions, yielded more heavily than any of the light padi selections.

Attention should be directed towards avoiding patches which contain logs or holes and such defects should, if finances permit, be removed.

Dong Test Plot, Raub, Pahang.

Conditions appeared to have been normal during the past season in this area, since good average crops were reaped, the general calculated mean yield for the Station being 2840 lbs. of padi per acre. Eleven selections were tested against a local popular but mixed type (Jambak bawang) in 1/40 acre plots replicated 6 times in randomised blocks, but two selections, Serendah 12 and Nachin 27, which ripened much earlier than the rest, were destroyed by birds and have, in consequence, been omitted from the calculations. The results are summarised in Table III and show that 7 of the selections proved superior in yield to the control type. Siam 29, though inclined to lodge, produced the highest crop and was significantly better than Radin 4 and those below it in yield, while Nachin 10 gave a better crop than Seraup 36 but is disliked because of its weak straw and should be replaced by the stouter strawed Nachin 66, which practically equals it in yield. Radin 13, which in several previous seasons gave such good yields at this Station, gave a better crop, but not to the extent of significance, than the other Radin strains but was outyielded by Siam 29 and Nachin 10. It may be mentioned that Seraup 36 and Radin 13 have already spread considerably in the neighbourhood of this Station. In trials next season care should be taken to plant all selections so that they will mature approximately at the same time.

Kendong Test Plot, Rembau, Negri Sembilan.

In this area eleven selections were planted for testing against a local popular type which appeared to be a mixture of Serendah 875 from previous distribu-

tions with a local Serendah kuning. Three of the selections, Radin Siak 10, Nachin 27 and Nachin 756, which ripened in advance of the general crop, were practically destroyed by the ravages of birds and rats and, in consequence, these strains have been omitted from the calculations. In a few plots soil conditions were poor and some plots were damaged by floods, irregular water supplies and pests in the early stages of growth, while rats and birds accounted for a fair amount of loss grain in a number of plots. However, despite these defects, the general mean crop was 1920 lbs. which is quite a fair return for this area under the conditions during last season. A summary of the results, given in Table III, shows too high a standard deviation but still the control type (mixed Serendah 875) was significantly better than Siam 29 and those of lesser yield, while Seraup 36 and Serendah 11 were the next best yielders. Siam 29 was lodged in a few patches at harvest with consequent slight loss of grain. Nachin 10 suffered severely in this respect. Selections for this area for next season should include Serendah 875, Nachin 66, Siam 29, Seraup 36, Radin 2, Radin 13, Mayang cbos 203, Nachin 756 and Radin Siak 17. Again it is necessary to stress the need for arranging planting so as to secure synchronisation of harvest for all lots, as nearly as possible.

Kuang Test Plot, Selangor.

With a view to growing two crops a year (at the suggestion of local cultivators) a change in season led to the sowing of nurseries in the hot months of February and March with subsequent heavy infestation of stem-borers. The young padi, after transplanting into the fields was again so severely damaged by these borers that it failed to recover vigour in time to produce satisfactory crops.

Six selections, planted in randomised plots, replicated nine times, included Serendah Nos. 741, 824 and 875, Nachin 27, Nachin 756 and Radin Siak 10, but the Serendah strains, owing to maturing later under local conditions, were completely destroyed by rats and birds, although growth was good and crops were promising. The other 3 strains suffered from drought at flowering time, in addition to stem-borers, so that they gave very low yields averaging 1,040 lbs. per acre, Nachin 756 being the best with 1130 lbs. per acre and receiving favourable comment by the cultivators. Under the adverse conditions which prevailed a high standard deviation (9.3 per cent.) was to be expected so that no significance is shown nor can reliance be placed on the results given in Table III.

Kajang Test Plot, Kajang, Selangor.

In this area four early maturing selections, Nachin 27, Nachin 756, Serendah 824 and Radin Siak were compared in 1/40 acre plots replicated 7 times. The growth of all the selections was good, water being sufficient and little damage being wrought by pests. The Serendah 824 ripened later than the rest and

suffered from lack of water too soon, due to drainage while the other selections were maturing.

Nachin 27 with a calculated mean yield of 1970 lbs. per acre was superior to the remaining selections, while Nachin 756 is distinctly promising but the Radin Siak proved a failure under existing conditions. Nachin 27 has given satisfactory crops in this area for several seasons and is spreading in the district.

Temerloh Test Plot, Pahang.

At this Test Plot the formation of the 'paya' is not amenable to water control so that the padi is always liable to suffer from floods or drought. With random distribution of plots within a sufficient number of well disposed blocks the effects of local conditions became fairly well averaged for all varieties included in the tests, nevertheless, more satisfactory crops and more reliable results might be obtained should it be found practicable to divide the area by suitably placed 'batas' into level blocks for water control purposes. In the last season a comparison between the local popular type, Seri ayer, and 7 selections was made in 1/40 acre plots replicated 9 times in randomised blocks. One selection, Nachin 27, which was promising in appearance, ripened considerably in advance of the local padi and was, in consequence, entirely destroyed by birds and this strain has, therefore, been omitted from the calculations which are summarised in Table III. The results show that Serendah 875 is, for all practical purposes, significantly superior to the local control type, despite a very high standard deviation. The local control showed superiority over Radin 4 and Radin 7, these 3 types taking 9 months to mature as compared with 6½ months for Serendah 875.

Serendah 875 and Radin 13 have already spread considerably in Pahang East.

Pekan Test Plot, Pekan, Pahang.

At this area 5 selections were compared with the local popular padi Mileh puteh in 1/40 acre plots replicated 6 times in randomised blocks. A few plots suffered from lack of water but a fair calculated mean yield of 1360 lbs. per acre was harvested. No positive significance has been found in the results which are shown in Table III, but Radin 13 (8 months) Radin 2 (7 months) and Nachin 27 (6 months) produced crops considerably in excess of the local padi Mileh which was lodged at harvest and required 8½ months to mature. Radin Siak 10 which matured in 6 months also outyielded the local type, while Serendah 875 (6 months) almost equalled it.

In local multiplication plots, Serandah 875 gave good yields, reaching 2170 lbs. per acre at Temai and 1520 lbs. per acre at P. Rusa. This padi has spread in certain areas in the Pekan district, although it did not show up well in the Test Plots last season.

TABLE III.

Dong Test Station, Raub — Pahang.

Variety	Sm. 29	N. 10	R. 13	R. 4	R. 2	Sr. 875	S. 36	M. 210	P.P.I.	Cont.	G.M.	S. Diff.
Plot M.	89.3	83.3	76	71.2	70.7	69.5	68.2	65.3	61.8	54.5	71.1	13.3
% of G.M.	125	117	107	100	99	98	96	92	87	77	100	19

Kendong Test Plot — Rembau — Negri Sembilan.

Variety	Cont	S. 36	Sr. 11	Sm. 29	N. 10	R. 13	R. 28	M. 206	R. 2	G.M.	S.D.	S. Diff.
Plot M.	66	54	54	48.5	46	43	41	41	39.5	48.1	4.37	13.7
% of G.M.	135	112	112	101	96	91	83	83	82	100	9	28

Kuang Test Plot — Kuang — Selangor.

Variety	N. 756	R.S. 10	N. 27	G.M.	S.D.	S. Diff.
Plot M.	28.3	26.8	22.9	26.0	2.41	7.2
% of G.M.	109	103	88	100	9	28

(*contd.*) Temerloh Test Plot — Temerloh — Pahang.

Variety	Sm. 875	Local	S. 36	R. 13	R. 2	R. 4	R. 7	G.M.	S.D.	S. Diff.
Plot M.	57.8	47.7	43.4	41.7	39.2	27.5	27.5	40.7	3.6	10.6
% of G.M.	142	117	107	102	96	67	67	100	9	26

Pekan Test Plot — Pekan — Pahang.

Variety	R. 13	R. 2	N. 27	R.S. 10	Contl.	F. 875	G.M.	S.D.	S. Diff.
Plot M.	38.5	38.0	35.3	32.3	30.2	29.3	33.9	3.2	10.3
% of G.M.	113	112	104	95	89	86	100	9	30

S. = Seraup, M. = Mayang ebos, R. = Radin.
Sm. = Siam, R.S. = Radin Siak, N. = Nachin, Sr. = Serendah,

Bukit Merah Test Station, Butterworth.

A calculated general mean yield of 1940 lbs. per acre from the Test Plots in this area indicates that the last season was only a fair one. Insects, particularly 'bena' (*Nephotettix bipunctata*) wrought a variable amount of damage especially in the Seraup and Santap plots which also suffered considerably from drought. Stem-borers were also conspicuous and decreased the crops slightly.

Nachin 10 and Siam 29 became badly lodged at harvest but in the dry weather gave good returns.

Eleven selections were tested against the local popular Mayang ebos; the results given in Table IV show that this control variety outyielded all the selections and was significantly better than the selected Mayang ebos 205 and those of lesser yield.

Nachin 756 gave the next highest crop and was closely followed by Siam 29 and Nachin 10.

Seraup 15, in the previous season, gave the best crop in these Test Plots and, with Nachin 10, outyielded the local Mayang ebos though there was little difference between their crops. The Seraups undoubtedly suffered severely from adverse conditions in last season. Mayang ebos 203 and Serendah 824, which both showed promise in the previous season, were omitted from the tests. In next season pure line selection should be inaugurated with the local variety Mayang ebos since it has proved a reliable and heavy cropper in the past 3 seasons and is popular for eating.

Glugor Test Plot, Penang.

This Test Plot suffered a good deal from flood and from borers, so that crops were only fair for the district, the calculated general mean yield being 1,900 lbs. per acre. Ten selections were compared with a local acclimatised type but the early-ripening strains, Radin Siak 10 and Nachin 27, were so severely damaged by flood that they have been omitted from the calculations. The control type was found to be Seraup 15 derived from former distributions in the neighbourhood. The tests were carried out in 1/40 acre plots in randomised blocks replicated 6 times and the results are summarised in Table IV which shows definitely that the Seraup strains (including the control, S. 15) were significantly better yielders in this area than the lighter types of padi under the conditions which prevailed during the season. The same strains were significantly better than the control in season 1930-31 when they were closely followed by Radin 4, as in the season under review. (In season 1931-32 the crop was destroyed by rats). Most of the earlier ripening types were too long in the fields and probably suffered from over-ripeness; Nachin 756 and Siam 29 gave the best crops and were closely followed by Nachin 10 and Radin 2. In the next season, the Seraup types might be tested independently of the earlier maturing types, care being taken that planting is arranged so that all strains can be harvested about the same time.

TABLE IV.

Province Wellesley and Penang.

Bukit Merah Test Station.

Variety	Contl.	N. 756	SM. 29	N. 10	M. 205	N. 27	SM. 63	R. 13
Plot M.	60.0	57.0	55.5	54.0	50.3	49.8	48.6	46.5
% of G.M.	124	118	115	112	104	103	100	96

Variety	R. 2	S. 36	S. 15	F. 39	G.M.	S.D.	S. Diff.	
Plot M.	43.8	40.6	38.6	36.5	48.4	2.6	8.0	
% of G.M.	90	84	80	75	100	5	17	

Glugor Test Plot

Variety	Contl.	S. 36	S. 15	R. 4	N. 756	SM. 29	N. 10	R. 2
Plot M.	64.1	63.6	62.8	45.3	42.8	41.3	39.3	38.5
% of G.M.	135	134	132	95	90	87	83	81

Variety	R. 13	G.M.	S.D.	S. Diff.	S. = Seraup, M. = Mayang ebos,
Plot M.	31.0	47.6	3.8	12.1	SM. = Siam, R. = Radin,
% of G.M.	65	100	8	25	N. = Nachin, F.39 = Santap.

Sungei Tontong Test Station, Dindings.

This Test Station was inaugurated last season and the land was laid out to compare 7 selections with a local popular type (Sri panji) in 1/40 acre plots in randomised blocks with six replications. The nurseries, however, were sown so late that weather conditions did not harmonise with planting operations and the padi suffered severely from drought at flowering time and from rain, rats and birds during the harvest. In consequence very small crops were reaped and the results obtained are of no value except to indicate that Siam 29, Serendah 824 and Radin Siak 10 withstood the prevalent conditions better than the other selections. The dates of planting operations should be advanced considerably next season when trials should be arranged so as to synchronise harvesting as much as possible.

Pulau Gadong Experiment Station, Malacca.

At this Experiment Station tests were carried out with three varieties, Siam, Nachin and Radin Siak, in plots of 100 square feet (100 plants) replicated five times in randomised blocks. With regard to the Siam variety the calculated mean yield per acre was 2,530 lbs. and Siam 29 again gave significantly better results than the remaining strains which did not prove better than local unselected padi Siam. The five Nachin strains produced a calculated mean yield of 2,420 lbs. per acre but no significance was evident in the results, which show that N. 66 and N. 11 gave slightly higher returns than N. 10 to which they are superior in straw strength. Eight Radin Siak selections were compared with the local unselected seed to which 7 of the selections proved definitely superior, though the unselected plots were damaged by rats to some extent. The Radin Siak types ripen very early and may prove very useful in areas where short wet seasons are experienced. The results are summarised in Table V in which yields are given in 1/10 lbs. per plot for Siam and Nachin selections but for the Radin Siak types yields are given in 100's of grammes per plot.

Numerous multiplication plots at this Station gave excellent measured yields at harvest, amongst which mention may be made of Siam 76 (2,800 lbs. per acre) Nachin 66 (2,900 lbs. per acre) Melek puteh 2 (2,400 lbs.) Melek kuning 3 (2,300 lbs.) Serendah 824 (2,300 lbs.) Nachin 27 (2,150 lbs.) and Radin 11 (1,800 lbs.). A considerable amount of seed distribution has taken place, not only in Malacca but to other States where Siam 29 has been proved of value.

Telok Chengai Experiment Station, Alor Star, Kedah.

At this Experiment Station pedigree line selection, which has been in operation for the last two years, shows promise of valuable results with 7 local popular varieties but further tests are necessary before the best selections can be determined. The local varieties are Riong, Radin Che Nah, Radin China,

TABLE V.

Variety	Sm. 29	Sm. 18	Sm. 76	Sm. 72	Local	M.	S.D.	S. Diff.
Mean	10.08	8.24	8.12	7.96	7.54	8.38	.28	.93
% of G.M.	120	98	97	95	90	100	3.4	11
Variety	N. 66	N. 11	N. 10	N. 70	Local	M.	S.D.	S. Diff.
Mean	8.38	8.28	8.12	7.66	7.66	8.02	.24	.78
% of G.M.	104	103	101	95	95	100	3	10
Variety	R.S. 18	R.S. 17	R.S. 7	R.S. 69	R.S. 9	R. S. 24	R.S. 25	R.S. 100
Mean	36.6	36.4	36.2	35.6	34.8	34.8	32.0	26.6
% of G.M.	112	111	110	109	106	106	98	81

Variety	R.S. Local	G. Mean	S.D.	S. Diff.
Mean	22.2	32.8	1.5	4.8
% of G.M.	68	100	4	15

Mayang ebos, Kunchor, Chubai and Chempah puteh and, so far, the first four show greatest promise. Good crops were harvested from various selections grown in single multiplication plots varying in area from half an acre up to 3 acres at this Station and the Table below shows the calculated average yields obtained, the mean yield for all the selections being 2,530 lbs. per acre.

Selection	Grain per acre	Selection	Grain per acre
Riong 6	3,160 lbs.	Radin 2	2,360 lbs.
Radin Che Nah	3,090 „	Radin 7	2,360 „
Serendah 824	2,860 „	Mayang ebos	2,280 „
Radin China	2,760 „	Seraup 15	2,230 „
Nachin 10	2,650 „	Radin 13	2,220 „
Siam 29	2,570 „	Seraup 36	2,210 „
Nachin 27	2,480 „	Radin 4	2,170 „

Where the selection number is omitted, the seed used consisted of a mixture of 2 or more selections of the variety named.

Varietal tests were carried out in this State at four Test Plots situated in the main padi areas of the State. At each area the tests were conducted in 1/45 acre plots replicated 6 times in randomised blocks. The results, summarised in Table VI indicate that Seraup selections give increased yields in the deep soft soil areas, while Siam 29 and Nachin 10 give excellent crops in the typical hard soil areas and, though both these strains suffer from lodging, good crops are reaped since harvest weather in Kedah is usually dry.

Sala Kanan Test Plot.

This plot is representative of the deep, softer soils found in parts of Kedah ("gelam" land) and comparisons were made between three Seraup selections and two local popular types, Mayang ebos puteh and Seri raja. Growth was fairly good, the calculated mean yield per acre being 2,210 lbs. but a few plots suffered somewhat from stem-borers and deep water. The summary of results given in Table VI shows that Seraup 48 gave significantly better crops than the controls. In the previous season, Seraup 15, Seraup 36, and Radin 7 gave better crops than the controls but Radin 7 was omitted last season because its rice is unpopular for eating.

Rantau Panjang Test Plot.

In this area 3 selections were tested against 3 local popular types, (Anak kuching, Ibu kuching and Riong) under fair conditions and produced a mean calculated crop of 2,220 lbs. per acre. The summarised results in Table VI show that Siam 29 gave significantly better crops than two of the control types and was considerably better than the third control, (Anak kuching) while Nachin 10 was almost equal in yield to Siam 29.

Langgar Test Plot.

Three selections were compared with 3 local popular types, (Melor, 'Toh Seman and Radin puteh) in this area and the results (Table VI) confirmed those of the previous season in that Nachin 10 proved signficantly better than any of the controls.

Soil conditions being apparently somewhat poor, the calculated mean yield per acre, 1,730 lbs., was low and eel-worms were destructive in patches, especially to the Radin selections, which appeared to suffer severely from this pest. Possibly earlier ripening types might be more suitable in this area and Radin Siak 17, Nachin 756, Siam 29, Nachin 10, Nachin 66, Radin 2 and the local padi Melor might usefully be tested next season.

Jitra Test Plot.

Stem-borers and fresh water crabs damaged the crops at this Plot, vitiating the results, but growth was good and a fair mean crop calculated at 2,065 lbs. per acre was harvested.

The results (Table VI) show too high a significant difference between means and no significance is revealed. Two local types, Mayang batil and Radin Siam, produced the highest crops, while Radin 13 and Radin 4 were favourably commented on by the cultivators. In the previous season Nachin 10 gave significantly superior crops in this area but was omitted in last season's tests.

TABLE VI.

Kedah Test Plots.

Locality	Variety	S. 48	S. 15	S. 36	ME. P	S.R.	G.M.	S.D.	S. Diff.
Sala Kanan	Plot M.	54.0	49.3	47.8	47.5	47.5	49.2	2.0	6.2
	% of G.M.	110	100	97	97	97	100	4	13
	Variety	Sm. 29	N. 10	A.K.	I.K.	Riong	R. 2	G.M.	S. Diff.
Rantau Panjang	Plot M.	58.5	57.2	51.3	49.2	42.5	37.7	49.4	8.34
	% of G.M.	118	116	104	100	86	76	100	17
	Variety	N. 10	Mel.	Tok. S.	R. Put.	R. 2	R. 13	G.M.	S. Diff.
Langgar	Plot M.	46.3	40.8	37.5	37.0	36.5	32.8	38.5	3.56
	% of G.M.	120	106	97	97	76	85	100	9
	Variety	M. Bat.	R.S.	R. 13	R. 4	R. Put.	R. 2	G.M.	S. Diff.
Jitra	Plot M.	51.2	49.2	45.6	45.0	43.2	41.6	45.9	14
	% of G.M.	111	107	99	98	94	90	100	30

Pasir Puteh Test Station—Pasir Puteh, Kelantan.

In this Station 7 wet padi selections were compared with 9 local popular types in 1/220 acre plots replicated 7 times in randomised blocks.

Judging by the general mean crop of 1,540 lbs. of clean padi per acre, the past season was a fairly representative one for the district though possibly the dry weather set in a trifle too soon and thus slightly lessened the crops, but, with so many types under comparison, the general mean yield is satisfactory.

The results are shown below in the order of mean yields per plot in lbs. and in percentages compared with the general mean yield (7.0 lbs.)

TABLE VII.

Variety	Sm. 29	N. 10	R. 13	A.I.T.	R. 4	Manik	P Treng	Sr. 824	N. 27
M. of Plots	9.0	8.5	7.7	7.5	7.45	7.45	7.45	7.15	6.95
% of G.M.	128	126	109	107	106	106	106	102	99

Variety	P.P.	Raub	A.I.S.	Chateh	Nalun	R. 2	Serdh.	G. Mean	S. Diff.
M. of Plots	6.55	6.4	6.37	6.3	5.9	5.85	5.5	7.0	1.35
% of G.M.	93	91	91	90	84	84	78	100	19

The results indicate that the selections Siam 29 and Nachin 10 are significantly better yielders than any of the local types while selections R. 13 and R. 4 have shown good yields compared with the next local types (A. I. Tinggi, Manik and P. Trengganu).

Kota Bahru Test Station—Kota Bahru, Kelantan.

In this area a comparison was carried out with local popular types of dry padi and one wet padi selection (Radin 2) in plots of 1/220 acre replicated eleven times in randomised blocks. The results are summarised in the following Table in which yields are given in lbs. per acre.

TABLE VIII.

Variety	Jentan koring	Sabumi puteh	Jentan manis	Muar padok	Kaki merpati	Muar pandan	Anak lebak
Mean	1,960	1,920	1,850	1,730	1,700	1,520	1,510
% of G.M.	123	121	117	109	107	96	95

Variety	Nurium	Kedah	R. 2	G. Mean	S.D.	S. Diff.
Mean	1,380	1,330	1,010	1,590	83	245
% of G.M.	87	84	64	100	5.2	15

The results indicate good average crops for dry padi in this area and that conditions did not favour the wet padi type—Radin 2. Padi Jentan koring, Sabumi puteh and Muar padok show definite superiority over padi Muar pandan and those below it in order of merit. Padi Nurium and Kedah mature some-

what earlier than the others under trial and gave proportionately quite fair crops. Tests of the better types will be repeated next season.

It might be mentioned that good crops were reaped from several selected types grown in numerous plots scattered over the wet padi areas of Kelantan, the most promising selections being Radin 2, Siam 29, Nachin 66, Mayang 210 for the lighter soil areas and Seraup 15, Seraup 36 and Seraup 48 in the heavy deep soils.

Johore.

Varietal trials of selected strains of padi were inaugurated in Johore along standardised lines in the past season. As no financial provision had been made for these trials and as it was already a trifle late before a commencement was made, it was necessary to depend on Penghulus and others interested in the cultiatvion of padi, for assistance in the matter of land and supervision. Six centres were selected as representative areas and, in every case, land and all labour were provided free by the Penghulu or cultivator concerned, incidentals alone, amounting to $25 to $30 at each centre, having to be paid for by the Department of Agriculture. The local demand is for padi of not more than six months' maturation period and the following strains were selected for the first year's trials, seed being supplied from Pulau Gadong Padi Experiment Station in Malacca :—Siam 29, Siam 19, Nachin 10, Nachin 11, Nachin 66, Nachin 27. Two local popular types were used in each case as control varieties.

At each centre the lay-out consisted of randomised blocks replicated six times, each block containing all the varieties in the comparison, planted in 1/80 acre plots. All the Nachin 27 plots matured considerably in advance of the other strains and in consequence this strain has been omitted in calculating the results since, in every case, the crop was so severely damaged by pests that it was hardly worth reaping. Table IX gives a summary of the results treated statistically, yields being shown in pounds of cleaned padi while percentages are given to the nearest whole number.

Labis Test Plots.

These Test Plots are situated 3 miles from the main road in the main padi area of Labis although they are only accessible by a jungle path. The yields per acre show that the soil conditions are very good and water supply was abundant and controllable. The results show that Siam 29 and Nachin 11 (for practical purposes) are significantly better than both the local control varieties. All the strains under trial were lodged in varying degrees but the rayats were favourably impressed with the results. For next season Nachin 66 and Siam 18 and the local Serendah puteh might be replaced by Radin 2, F. 27 (planted to ensure maturity at the same time as the other lots) and Seraup 48—three strong strawed types, and Mayang chos 201 might be added, if practicable, in the area available.

TABLE IX.

Labis	Variety	Sm. 29	N. 11	Sm. 18	N. 10	N. 66	S. Kun.	S. Put.	G.M.	S.D.	S. Diff.
	Mean	46.1	45.3	41.8	39.5	38.5	38.5	36.6	40.9	2.26	7.1
	M. per ac.	3688	3624	3344	3160	3080	3080	2928	3272	181	568
	% of M.	113	111	102	97	94	94	89	100	5.5	17
Pulau Penari	Variety	N. 11	S. 29	Sultan	N. 66	S. 18	N. 10	S.Kamp	Mean	S.D.	S. Diff.
	Mean	40.5	40.1	39.5	39.3	38.5	37.8	30.8	38.0	1.86	5.86
	M. per ac.	3240	3208	3160	3144	3080	3024	2464	3040	149	469
	% of M.	107	105	104	103	101	99	81	100	4.9	15
Tangkak	Variety	S. 29	Sultan	N. 66	S.Kamp	S. 18	N. 11	N. 10	Mean	S.D.	S. Diff.
	Mean	42.0	35.5	33.6	32.8	30.6	28.6	26.5	32.8	2.36	7.44
	M. per ac.	3260	2840	2688	2624	2448	2288	2120	2624	189	595
	% of M.	128	108	102	100	93	87	81	100	7.2	23
Sungei Balang	Variety	S. 29	N. 10	N. 11	N. 66	B. Ber.	Peteh	S. 18	Mean	S.D.	S. Diff.
	Mean	33.6	27.5	26.3	23.5	19.8	18.6	17.6	23.8	2.3	7.35
	M. per ac.	2688	2200	2104	1880	1584	1488	1408	1904	184	588
	% of M.	141	115	110	98	83	78	74	100	9.6	31

The two areas, Ayer Hitam and Yong Peng, have not been treated statistically as both areas were planted very late and practically obliterated by pests, especially rats and birds.

Pulau Penari Test Plot.

This area is easily accessible by road, is representative of the area in which it is situated, has fertile soil and is sufficiently watered.

With the exception of Nachin 66 all the selected types under trial suffered from lodging at harvest. The results show that all the selected types which were harvested are superior to the local padi Siam control, though none of the selections is superior to the other control type (padi Sultan) which may not have suffered so much from lodging. For next season the local control type of padi Siam, Siam 18 and Nachin 10 might be replaced by the strong strawed types Seraup 48, Radin 2 and Nachin 27 and care taken to plant them all so that they will mature approximately at the same time.

Tangkak Test Plot.

This Test Plot is situated near the town, is readily accessible and well watered. The growth of all strains was robust but all suffered severely from lodging before harvest, rendering that operation difficult and resulting in much loss of grain.

The results show that Siam 29 gave the best yield but was not definitely superior to the local padi Sultan. The poor yields from Nachin 10 and Nachin 11 indicate that they suffered excessively from lodging which may have vitiated the entire test in the season under review. The Siam Kampong, Siam 18 and Nachin 10 might be replaced in next year's trials by Nachin 27, Radin 2 and Seraup 48 as it is evident that some stronger strawed types are needed in this area, while, if space permits, Mayang ebos 201 and Radin 4 might also be added.

Sungei Balang Test Plot.

This area suffered from rats and deep water, (which hampered tillering) and from lodging at harvest, consequently much loss of grain was experienced; moreover, the standard deviation indicates that adverse factors wrought unequal damage with plots. The results show that Siam 29 and Nachin 10 gave significantly better crops than either of the local control types, while Nachin 11 and Nachin 66 also gave better crops but not to a significant degree.

This area is coastal and it is customary to transplant the padi twice so that it would be advisable to substitute Seraup 48 and Radin 4 for Siam 18 and the local padi puteh in next year's trials. Radin 2 and Mayang ebos 201 or 203 might also be added, if practicable.

In general, when due consideration is given to all the circumstances, the results of the padi trials in Johore have been satisfactory in indicating suitable types for the various areas; types in 3 areas showed significant superiority over the local popular types against which they were tested, while in the fourth area treated statistically, one selected type out-yielded the local control variety but not to the degree of significance. Padi Siam No. 29 and Nachin No. 11 show most promise but all the types tested suffered so much from lodging

that the inclusion of some stiff strawed strains in further trials would seem advisable and reference has, in this respect, been made to Seraup 48, Radin 2, Radin 4, Nachin 27 and Mayang ebos 203. In future, attention should be directed to the necessity of planting all the types under trial so as to synchronise reaping and thus minimise losses at harvest due to rats and birds. Further, in introducing new types of padi into various areas, it would be as well to get local cultivators' views on the palatability of the different selected strains which may show promise of heavy cropping ability.

General.

Recommendations as to the trials which should be carried out in the present season, were made earlier in the year and based on the results which have been summarised in this article. In accordance with the need for economy and without loss of accuracy this season's trials have been laid down as "Latin" squares with 1/120 acre as the standard size of plot in place of 1/40 acre (109th acre at Titi Serong) as in the past.

The use of some local popular type of padi as a control in trials has been discarded since last season's experience showed that practically all such control types were derived from previous distributions of selected padi. Such control types are now restricted to new areas, where a standard local type is desirable for comparison, or to areas in which selected strains have, so far, failed to give better returns than the local varieties. At the same time every opportunity is being taken for collecting, isolating and testing any really promising new types which may be found in cultivation, particularly amongst those varieties which mature within a period of 6 months. Further experiments have shown that fair crops of padi can be grown on abandoned, slimed, mining land after the incorporation of organic matter derived by growing green manures on the land for some years. Obvious difficulties render the work of following up the results of distributions of selected seed somewhat arduous but efforts in Krian district in the past season led to the conclusion that considerably more than half of the nothern area was planted with selected seed. Similar results were previously obtained in Raub district and a material amount of seed distribution has taken place in many other rice growing centres also. The more popular selections in cultivation are, for soft heavy soils, Radin 2, Radin 4, Seraup 15, Seraup 36 and Seraup 48 while, for other types of soil, Siam 29, Nachin 10, Radin 2, Serendah 824 and Nachin 27 have been planted on considerable areas with, generally, satisfactory results. Ocular demonstrations of the productive value of selected padi strains, such as are now afforded at the numerous Padi Test Plots, will undoubtedly lead to an increasing and cumulative utilisation of seed.

Hybridisation.

Observations on the flowering characters of the more important padi types and a few crosses between them, were made in 1919 with a view to hybridisation

work. Pure line selection was, however, so promising at the time and so many lines were still under trial that further cross-breeding investigations were postponed until the large number of tested selections could be materially reduced in order that cross-breeding work should be confined solely to the most desirable selections. In 1928 - 29, when an officer became available for work, these investigations were continued and a fairly satisfactory technique was gradually established. The local breeding problem is the synthesis of a genotype combining heavy yield of grain with strength of straw and early maturity, since several otherwise desirable selections lack strength of straw, which is exhibited by other selections of varying maturation periods, and suited to varying environmental conditions.

In the past season, F. 3 seed of 20 hybrid types was sown and from the crops 6 promising selections were made after harvest for sowing as ear-to-row lines in next season for further study. The most promising of these F. 3 hybrids is a combination of the high yielding but late maturing Seraup 36 with the early maturing Radin 2. Other promising crosses of this generation include that between Radin 2 and the still earlier ripening Nachin 27. In addition, F. 1 seed resulting from crosses of Siam 29 with Serendah 875, (17 plants) and with Radin 2 (16 plants) was harvested for sowing in ear-to-row lines next season. These two crosses were made with a view to producing an improved type combining the yield qualities of Siam 29 with the stronger straw of Radin 2 and Serendah 875 and may prove very useful. In planting out these hybrids, the importance of planting single seedlings per hill is stressed as otherwise deductions derived from individual plant examinations become unreliable and of uncertain value. Future breeding work will be limited to crosses of special practical value such as combinations of Nachin 10 and Siam 29 with stiff strawed types.

Summary.

1. Selected strains of padi have been found suitable for most soil conditions in Malaya.
2. In many areas, selected strains have been shown to be productive of better crops than local unselected seed.
3. The increased number of Test Plots has brought padi investigations into closer touch with the cultivators and thus considerably widened the scope for seed distribution.
4. The search for still better strains is being maintained and efforts are in progress to improve existing selections by hybridisation methods.

The following Tables give the figures obtained from mechanical and chemical analyses of the soil from the different Stations.

Soil Analyses.

(*a*) Mechanical.

Stations		Percentages					
		Clay	Silt	Fine Sand	Coarse Sand	Gravel	Loss on Ignition
Kendong	T	32	9	43	10	5	7
	S	36	9	36	10	8	8
K. Kurau	T	73	8	7	—	—	14
	S	—	—	—	—	—	59
Selinsing	T	71	13	7	—	—	10
	S	68	7	6	—	—	5
Briah	T	59	20	17	—	—	13
	S	65	16	13	—	—	5
Bruas		57	8	19	9	5	12
B. Gantang	T	53	12	29	7	—	12
	S	41	8	28	12	12	7
Kajang	T	71	7	17	—	—	12
	S	73	7	15	—	—	12
Kuang	T	32	5	41	18	4	6
	S	30	4	43	18	6	5

T = Top-soil. S = Sub-soil.

(b) Chemical.

Stations		Percentages						
		C	N	CaO	Sesquioxides	K_2O	P_2O_5	MgO
Kendong	T	1.95	.169	.035	10.64	.211	.0210	.0027
	S	1.32	.107	.027	14.67	.215	.0168	.0014
K. Kurau	T	1.96	.172	.133	20.33	.855	.0344	.1988
	S	1.59	.133	.118	15.87	.757	.0455	.0617
Selinsing	T	3.78	.273	.069	21.05	.739	.0342	.0799
	S	2.37	.140	.043	14.11	.699	.0385	.0487
Briah	T	2.83	.231	.045	17.41	.650	.0609	.1197
	S	1.89	.122	.053	23.38	.812	.0319	.0409
Bruas	T	1.90	.151	.040	23.00	.438	.0707	.0395
B. Gantang	T	2.58	.224	.034	22.56	.508	.0620	.0104
Kajang	T	1.79	.161	.039	26.00	.518	.0651	.0031
	S	1.83	.172	.038	26.70	.634	.0518	.0043
Kuang	T	1.50	.096	.038	13.50	.297	.0693	.0036
	S	1.31	.089	.041	17.80	.378	.0630	.0081

T = Top-soil. S = Sub-soil.

PADI MANURING EXPERIMENTS 1932-33.

BY

W. N. C. Belgrave.

Chief Research Officer.

As stated on page 638 of this Journal for December, 1932, the main padi manurial experiment of the Season 1932—1933 was designed to test the possibility of obtaining large increases of yield by combining manuring with close planting. There were also small subsidiary experiments to test the effect of cattle manure, of heavy dressings of nitrogen and of "chelupping" i.e. the dipping of the seedling plants before transplanting in a paste of phosphatic manure.

In Kelantan for the first time an experiment was laid down to test response to manure of various kinds.

Planting Distance, Preparation and Manuring.

Experiments were carried out at the Stations at Telok Chengai, Titi Serong, Talang, Bukit Merah and Pulau Gadong. Unfortunately entirely reliable results were obtained only from the first two Stations; there was severe insect attack in early stages at Bukit Merah, the experiment was entirely spoiled by rats at Pulau Gadong and at Talang recently levelled land was used with resultant uneven growth.

Soil preparation was as follows :—

Telok Chengai :	Ploughed, raked and rolled.
Titi Serong :	Tajaked twice (the second clearing being necessary on account of lack of water and consequent delay).
Talang :	Changkolled twice.
Bukit Merah :	Ploughed (three times) and raked.
Pulau Gadong :	Ploughed, harrowed, ploughed, harrowed (three times).

Chelupping.

The Malay practice of "chelup" consists of dipping the roots and lower parts of the seedlings immediately after their removal from the nursery into a soft paste of manure and water to which earth is sometimes added. The seedlings are then stacked in a shady place for one or three days during which time numerous adventitious roots, copiously covered with root hairs, push through the thin coating of paste adhering to the plants. The practice is followed in parts of Kedah, Province Wellesley and Malacca.

During the course of the season it was ascertained that the method used for "chelup" in connection with the manurial experiments had varied in different places and in Perak, for instance, where the custom of "chelup" does not obtain, seedlings were simply dipped before planting and the stacking part of the process was omitted. Consequently most of the paste was probably shaken or washed off the seedlings during the operation of planting.

The practice actually adopted at the different Stations is tabulated below :—

Telok Chengai :	Dipped in paste of local bat guano and water and stacked for two nights.
Titi Serong :	Dipped in paste of Perlis phosphate and water : no stacking done.
Talang :	Dipped in paste of bone meal and water and stacked for one night.
Bukit Merah :	Dipped in paste of bone meal and water and stacked for two nights.
Pulau Gadong :	Dipped in paste of Perlis guano, clay and water (one part of Perlis guano to two of clay) and stacked for one night.

Manurial treatments were —

A. Chelupping with bone meal or local bat guano.
B. Superphosphate supplying 60 lbs. Phosphoric Acid per acre.
C. Ammonium sulphate supplying 20 lbs. Nitrogen per acre + superphosphate as in B.
D. Control.

Four replications of each treatment on plots of such a size that 1/40 acre could be measured, leaving sufficient guard rows to exclude bund effect, were employed. These were arranged in a Latin Square, or, where considerations of space prevailed, in a double row on the Latin Square principle. Each plot was provided with bunds, except in Krian.

Each plot was further subdivided into three sub-plots of 1/120 acre each, without bunds, in which planting distances were respectively, that normal to the district, three inches closer each way and six inches closer. Sub-plots were randomised.

It should thus be possible to test the effect of manures, of planting distance and of the interaction of the two.

For the sake of clarity results have been given in Tables A and B in round numbers, weighings were actually made to quarter pounds and for statistical analysis these more accurate figures were employed. Application of the "z" test showed that the differences between manurial and planting distance responses and the reaction between planting distances and manures were all significant, while the "p" values gave the minimal significant differences shown in Table C.

Telok Chengai, Kedah. Padi used—Selected strain Radin 2.

TABLE A.

Telok Chengai.

Planting Distance.	Yield in lbs. per 1/120 ac. sub-plot.	Calculated yield in gantangs* per acre.	Percentage of control† = 100.	Average tillers per plant§.
		A. Chelupped		
15″ x 15″	20	418	100	15.3
12″ x 12″	23	480	115	11.7
9″ x 9″	24	500	120	7.8
		B. P. Manure		
15″ x 15″	26	543	130	15.9
12″ x 12″	27	564	135	13.4
9″ x 9″	27	564	135	9.5
		C. NP Manure		
15″ x 15″	26	543	130	18.6
12″ x 12″	28	584	140	14.4
9″ x 9″	24‡	500	120	9.0
		D. Control		
15″ x 15″	20	416	100	15.4
12″ x 12″	23	478	115	11.8
9″ x 9″	22	460	110	7.4

* 1 gantang = 1 Imperial gallon. Weight of 1 gantang of padi from this field = 5.75 lbs.
† Control is taken as unmanured planted 15 x 15 ins.
§ 20 plants counted.
‡ Damaged by rats.

TABLE B.

Telok Chengai-Summarised.

Manures	Gantangs per acre.	Percentage of Control* = 100.
Chelupped ...	466	103
P Manure ...	557	123
NP Manure ...	542	120
Control ...	452	100
Distance planted		
15″ x 15″ ...	480	100
12″ x 12″ ...	527	110
9″ x 9″ ...	506	105

* Control is taken as unmanured for manures and 15 ins. x 15 ins. for distance.

TABLE C.

	Between any pairs (pounds).	Percentage increase over control.
Manurial treatment (1/40 ac.) ...	1.6	2.6
Distances (1/120 ac.) ...	2.5	10.60
Combination of manure and distance (1/120 ac.) ...	3.3	12.8

The standard deviation of a single 1/120 acre sub-plot was 8.65 per cent. of the mean, a satisfactory result which proved the contention of p. 639 of this Journal for December 1932 that such plots would suffice for the accuracy required.

Adopting these standards of accuracy we see that all manurial treatments have given significant increases and that planting 12 ins. x 12 ins. is definitely superior to 15 ins. x 15 ins.

From the economic point of view however the experiment has failed and the 'bar' alluded to in previous reports has not been surmounted. At the present low price of padi the response obtained would cover the cost of only the cheap local manure.

Titi Serong, Krian, Perak. Padi used—Pedigree strain N. 27.

TABLE D.

Showing Mean Yields in Pounds per 1/120 acre.

Distance	A. Chelupping	B.P Manure	C. NP Manure	D. Control.
14″ x 14″	17	18	17	16
11″ x 11″	14	17	15	17
8″ x 8″	17	17	16	15

Cursory inspection of these figures suffices to show that no economic results have been obtained and further that, here, closer planting has been without result. Owing to the presence of a few scattered very low-yielding plots the experimental error was high, standard deviation for one 1/20 acre sub-plot being 13 per cent.

Talang and Bukit Merah. As stated above results from these two Stations cannot be regarded as reliable; for what they are worth, neither significant nor economic increases have been obtained as a result of manuring or closer planting.

Manuring Experiment in Kelantan.

Pasir Puteh. Manurial experiments were carried out for the first time on this Station. The layout was in six randomised blocks of plots of 1/40 acre reaped, without bunds.

Treatments and mean yields were :—

Treatments.	Pounds per 1/40 acre.	Gantangs per* acre.
1. Basic slag 2 cwts. Cyanamide 1½ cwts. Sulphate of Potash 1 cwt. per acre	64.3	460
2. Superphosphate (16 per cent.) 2 cwts.	55.2	402
3. Superphosphate + Sulphate of Ammonia 1½ cwts	58.5	417
4. Basic slag 2 cwts. + Cyanamide 1½ cwts.	57.8	413
5. Green manure 1 ton	44.7	320
6. Local manure†	41.0	293
7. Local bat guano (P_2O_5 16 per cent. N 1.8 per cent.) 4 cwts.	56.3	403
8. Control	33.8	242

* Calculated from weight at the rate of 1 gantang = 5.5 lbs.

† A mixture of burnt soil, burnt cow dung and ashes of coconuts and areca leaves in general use in Kelantan under the name "Baja Bakar".

Statistical analysis shows that the standard deviation of a single plot is 6.8 lbs. or 11.2 per cent. of the mean and minimum increase over control for significance of P = .05 to be 7.1 lbs.; minimum difference between any two treatments for the same significance is 8.8 lbs. From these figures it follows that the increases due to green and local manure are just significant, while those from all other treatments are highly significant. Differences between treatments 2, 3, 4 and 7 are within the limits of experimental error and are probably due to chance, while the increase due to the addition of nitrogen and potash in treatment 1 over treatment 7 is probably real although the probability of chance occurrence is .07 instead of .05.

The nitrogen content of the bat guano employed is so small that it may safely be regarded as a phosphate manure only and as usual nitrogen is found to be unnecessary. Unfortunately there was no phosphate potash treatment without nitrogen so that it is impossible to say whether potash would have given additional response in the absence of nitrogen. The fact that response was forthcoming is however interesting, since, elsewhere in Malaya and in other tropical countries, potash has been found either to be useless or to have a depressing effect on yield.

The fact that there was no difference between the acid and basic mixtures 3 and 4 confirms results previously obtained elsewhere in Malaya and may owe its explanation to the change in the direction of neutrality found to occur on inundation of many local soils.*

It is interesting to note that the absence of bunds did not prevent attainment of sufficient accuracy.

From the economic standpoint, taking 1 gantang of padi as worth 5 cents ($1.00 = 2s. 4d.) the increase due to treatments 2—4 and 7 of approximately 167 gantangs per acre would be worth $8.35. This would be barely remunerative, if 2 cwts. of basic slag or superphosphate costing—say—$6.50 in Kelantan were used, but should be economic if bat guano can be obtained in quantity at cheap rates, more especially if, as is probable, there is residual effect, It may well be found by further work that smaller applications give the same result. The extra increase of 53 gantangs due to potash would be worth only $2.65 and would not be remunerative, even if potash without nitrogen produces the increase.

It must be remembered however that, in light soils, continued heavy cropping as a result of phosphate manuring may result in depletion of nitrogen or potash necessitating subsequent additions of one or both of these constituents if cropping is to be maintained.

The large increase obtained on this Station is interesting and recalls the similar increase obtained at Talang in 1930 - 32, when the plots were sited on an area giving control yields of only 247 gantangs per acre.

In neither case however was the general limit found in Malaya exceeded.

Subsidiary Experiment.

An experiment carried out at Pulau Gadong, Bukit Merah and Talang consisted of four treatments—

A. Cattle manure applied at the rate of 20 tons per acre.

B. Cattle manure at 2½ tons per acre + "ammonium phosphate"† (20 : 20) at 100 lbs. per acre.

C. Ammonium phosphate* (20/20) at 300 lbs. per acre preceded by an application of 200 lbs. of lime one month earlier.

D. Control.

Plots were of a size sufficient to give a measured area of 1/120 acre and there were four replications of each treatment arranged in a Latin Square or double banked modification thereof. Each plot was bunded as it was thought that there might be considerable diffusion of nitrogen from cattle manure.

The object of the small dressing of cattle manure in B was to provide possibly lacking bacteria and of the lime in C to neutralise possible development of acidity due to the heavy dressing employed.

* Dennett, J. H. This Journal, p. 518, Vol. XX, 1932.

† "Ammonium phosphate" is used as a generic term for Niciphos, Leunaphos, Ammophos and similar synthetic manures.

Pulau Gadong. Padi employed was Radin Siak, and results are shown in Table E.

TABLE E.

	Mean Yield.			
	lbs. per 1/120 ac.	lbs. per acre.	Gantangs per acre.	Percentage of Control = 100
A. Cattle	24	2880	510	140
B. Cattle + NP	22	2620	475	129
C. NP + Lime	20	2420	435	119
D. Control	17	2040	368	100

1 gantang has been taken = 5.5 lbs.

Statistical analysis gives standard deviation = 9.1 per cent. of mean and smallest difference between any pair for significance = 3.1 lbs. hence all treatments were significant; cattle manure was definitely better than ammonium phosphate and lime but no treatment was economic. There was severe lodging of padi on the manured plots.

Bukit Merah. Padi employed was Radin 4. Results are shown in Table F.

TABLE F.

	Mean Yields.	
	lbs. per 1/120 acre	Percentage of Control = 100
A. Cattle	18	120
B. Cattle + NP	17	114
C. NP + Lime	16	107
D. Control	15	100

Talang. Padi employed was Radin 2. Results are shown in Table G.

TABLE G.

	Mean Yields.	
	lbs. per 1/120 acre.	Percentage of Control = 100
A. Cattle	32	118
B. Cattle + NP	29	107
C. NP + Lime	31	115
D. Control	27	100

Since none of the responses at these two Stations are economical, statistical analysis has not been performed. It is noteworthy that the relatively high response from cattle manure obtained at Pulau Gadong has not been obtained here.

Other Manurial Experiments.

Simple strip experiments to test the efficacy of chelupping were carried out at Briah, Selinsing and Kuala Kurau in Perak; results were—Briah 11 per cent., Selinsing 18 per cent. and Kuala Kurau 1 per cent. increase over control. No result is significant. At Bukit Merah a simple experiment using well rotted buffalo dung was carried out and an increase of 5 per cent. over the control was obtained. This is well within the limits of experimental error.

Combined Cultivation and Manuring.

An experiment designed to test tajaking (scything of weed growth) as against changkolling (hoeing) combined with manuring was carried out at Selinsing, Perak.

Each treatment plot (*i.e.* changkol or tajak) was 3/80 acre in extent and was sub-divided into three sub-plots of 1/80 acre, each without intervening bunds, to which were applied phosphatic manure (P) at the rate of 200 lbs. of superphosphate per acre, nitrogenous and phosphatic manure (NP) at 100 lbs. of sulphate of ammonia + 200 lbs. superphosphate per acre and (C) Control. There were four replications of each treatment and therefore twelve of each manure.

Mean results expressed in terms of 1/80 acre plots were —

	Control.	P.	N.P.	Mean.
Changkol	21.00	24.00	27.25	24.08
Tajak	24.00	25.25	27.75	25.72
Mean	22.50	24.63	27.50	

Statistical analysis showed that the P was significantly better than Control and NP than P (the standard deviation was 2.3 lbs.).

Owing to administrative difficulties, application of manures could not be carried out until after flooding; in spite of this there is no evidence of diffusion. The difference between changkolling and tajaking is small. Had it been possible to carry out these operations earlier, greater differences might have resulted.

An experiment in which ploughing, changkolling and tajaking without manuring were compared at Bukit Merah gave, for the second year in succession, results of no economic significance; figures expressed as percentages are —

	Ploughing.	Changkolling.	Tajaking.
1931 — 1932	108	102	100
1932 — 1933	123	113	100

The only significant difference is that between ploughing and tajaking in 1932 - 33. At Talang a similar experiment showed no significant difference.

Summary.

1. The results of experiments in closer planting combined with manuring are examined and found to give results falling short of economic utility except on light soil in Kelantan, where there appears every chance of raising initially low yields to the level of those on heavy soils on the west coast of the Peninsula.

2. Manuring with cattle manure gave relatively a large increase on one Station out of three.

3. The "bar" of unknown origin discussed in previous reports, beyond which yields in Malaya cannot be raised by manuring, has not been surmounted.

Work in the Season 1933-1934.

In the summary of work 1931 - 32 (this Journal page 642 of 1932) it was shown that the turning in of green matter combined with manuring had produced large effects in experimental padi tanks at the Government Experimental Plantation, Serdang. During the past season tests were made of the effect of

turning green matter into the tanks, six weeks and one week before planting, and of leaving it on the surface. The experiments were largely spoiled by leaks in a large number of tanks, but it was clear that far better growth resulted from leaving the green matter on the surface than from turning it in. This, in a measure, is the practice in Krian and certain other areas in the country where weed growth is cut with a special implement just below the soil surface after flooding and is either left there to rot or, when present in large quantity, partially to rot, the residue being piled on the bunds.

A new series of experiments has been devised for testing in the field a combination of deep cultivation before and after fallow, tajaking, turning in and laying on the surface of green matter and manuring.

In Kelantan it is proposed to test smaller dressings of local phosphate and residual effect of the manures applied last season.

POT EXPERIMENTS WITH PADI.

BY

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The experimental work to be described below was set up as the result of a number of field investigations on padi soils.

Great difficulty arises as soon as any attempt is made to compare the appearance, rate of growth and yields of padi grown in different parts of the country. However carefully it is guarded, certain factors affecting results will apply to one area and not to another. There may be shortage of rain in one area, superabundance in another, a third area is, perhaps, badly attacked by pests while on a fourth results may be vitiated by the raids of rats and birds.

It therefore seemed a reasonable plan to collect soils from various parts of the country, as far as possible representative of well known areas, and to attempt to grow the same padi on all of them under exactly comparable conditions. Even if the conditions were not as good as in the field they would be exactly comparable with each other, but they should, if possible, be on the general lines of field trials.

Ordinary dry-padi trials in pots did not seem a very helpful line of approach. Previous experience frequently showed that growth was largely vegetative and formation of grain could not be depended on.

The scheme evolved therefore was to grow padi in pots, which should be sufficiently large to give the plants a reasonable area from which to draw their nutrition, and further that these pots should be irrigated.

The containers were made of unglazed earthenware with two holes in the side, one at the top and one at the bottom. The bottom was closed with a cork which could be removed to run off any seepage water if necessary. The upper hole was fitted with a cork through which a quarter-inch galvanised iron "bend" passed. The pots were placed on long series of stepped terraces with fifteen steps in all. Continually flowing water was supplied from taps to all the pots on the top terrace. The pots were filled with soil to within two inches of the upper hole. When water in the top row reached this hole it flowed through the "bends" into the pots on the step below and so on right down through the whole series of pots, the water from the bottom pots flowing off down the drain. Water was kept flowing sufficiently fast to prevent any possibility of mosquitos breeding. All the pots were enclosed in wire cages to keep out birds.

Each pot contained about 70 kilos (150 lbs.) of soil. Soils in the first case were obtained from :—

(1) Titi Serong (Perak).
(2) Selinsing (Perak).
(3) Pulau Gadong (Malacca).
(4) Kamunting (Perak), (reslimed mining land).
(5) Kuala Lumpur (ordinary type quartzite soil).

About two months later two additional soils were added —

(6) Lenggong (Perak) (high yielding area).
(7) Kuala Pilah (typical granite padi land).

Each lot of soil arrived in some twenty four sacks. The contents of each sack was carefully mixed and then mixed with the contents of the other sacks. The actual procedure was to take a portion from the sack equal to 1/30 of the total weight of the contents and mix it thoroughly with a similar portion from each of the other sacks. This finally mixed portion was roughly weighed into pots, there being thirty pots to each soil type.

These thirty pots were arranged in two lines down the fifteen steps of the terrace, but the two lines of the same soil were not contiguous, lines from the other four types coming between them.

There were then in the first place ten lines of pots arranged in fifteen rows one above the other. When the Lenggong and Kuala Pilah soils were added there were then fourteen lines in fifteen rows. The general lay-out will be readily realised from the photograph on Plate I.

The Objects of the Investigation.

What exactly were the questions which it was desired to answer? In the first season these were somewhat confined and were as follows :—

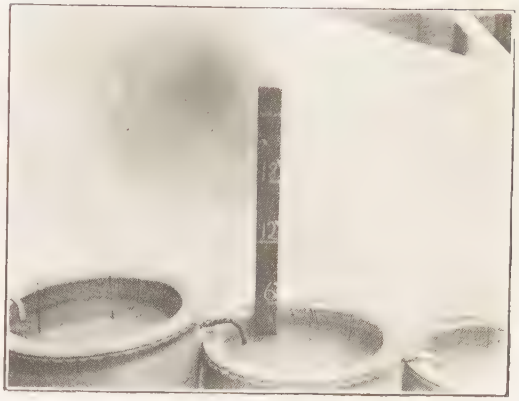
(i) would such a design of lay-out give a sufficiently even growth with each soil type to make any comparison of types possible?
(ii) if the answer to the first should be in the affirmative would the yields obtained be comparable with those obtained in the field?
(iii) would there be significant differences in the yields obtainable from the different soils under examination?
(iv) what differences are there in the soil to account for these differences in yield and would such observed differences (in soil) shew any relation to differences in yield?
(v) would the first year's results indicate the probable utility of the method for general manurial experimentation?

The answer to the above has been very satisfactory as a whole and has in some respects exceeded the writer's expectations. They are discussed in detail below.

One of the outstanding results has been the very even growth within each line. It was thought possible that there might be definite differences in the appearance of upper and lower pots. So even has the growth within lines shewed itself that it does not appear necessary to have the whole of one line

General view 2 months.

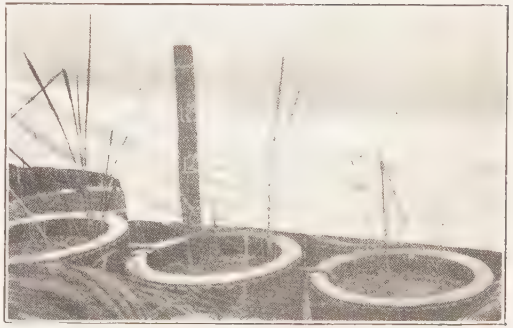
Kamunting 2 months.



Kuala Lumpur.

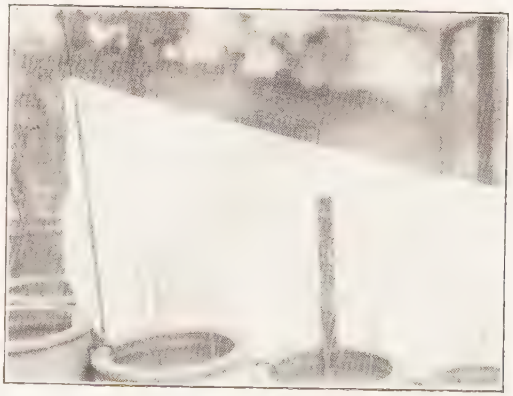
Lenggong 2 months.

Selinsing 2 months.

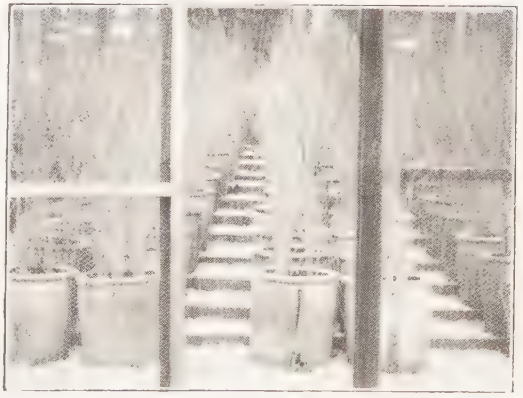


Kuala Pilah.

TITI SERONG 2 MONTHS.

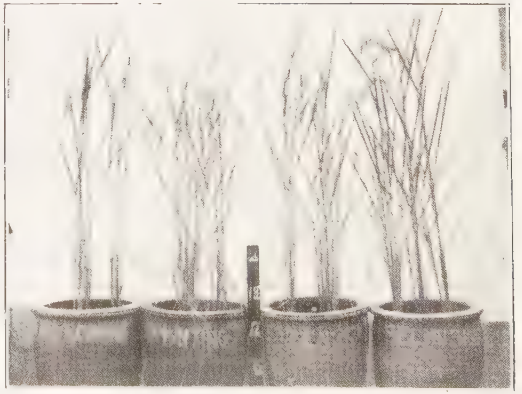


MALACCA 2 MONTHS.



GENERAL VIEW AT HARVEST.

LENGGONG AND TITI SERONG. AT HARVEST.



AT HARVEST.

concerned with one treatment only in any future manurial work. This evenness is most likely due to very careful mixing of the soil before potting.

Experimental.

The answer to the other four questions will be obtained by a discussion of the work carried out, the observations made and the crop yielded.

The nursery was planted in an extra pot of Malacca soil, the seed used being a Nachin F.S.27. Growth was even and rapid and the seedlings were planted out 21—23 days after the date of sowing *i.e.* 19.4.33. Water had been flowing over the planting out pots for 14 days previously. Growth did not appear to suffer any check after transplanting and the evenness soon became apparent; out of 450 plants only one required supplying. At an early stage it was realised that a fairly normal growth could be expected.

Some two months after planting it was decided to add soil from Kuala Pilah, as representing large areas of alluvial growth padi soils and, on the suggestion of the Director of Agriculture, soil from a known high yielding area (1,000 gantangs per annum) at Lenggong (Perak).

Observations.

Differences in vegetative growth soon became apparent. "Kamunting" forged rapidly ahead of the others, shewing very rapid tillering and from its general appearance, gave promise of good yields. Next came "Titi Serong" in which tillering and growth was less rapid but the plants appeared to be stronger with rather bigger leaves of a darker colour. Next in order came "Selinsing" which gave few tillers but all were sturdy. Fourth came "Malacca", general growth of which appeared rather poor at this stage. Last came the Kuala Lumpur quartzite. Four months after planting, although still green, the latter showed practically no growth from the nursery stage.

The two later soils, "Lenggong" and "Kuala Pilah", shewed remarkable differences. The former shewed much more rapid growth even than "Kamunting" and, in actual appearance, rapidly surpassed all the others which had been growing for two months longer. It did not tiller to quite the same extent as "Kamunting" but shewed a much stronger growth with less tendency for early tillers to die back, more coming to maturity. "Kuala Pilah" on the other hand shewed even a slower growth than "Malacca", with little tillering but with an intense dark green colour.

Flowering was first observed in the "Kamunting" pots on 27.8.33, four and a quarter months from planting out or five months from seed. At this stage the comparative positions had changed. Much of the energy of the "Kamunting" padi had been expended in purely vegetative growth and, although the number of flowering tillers was 3.7 per plant, the straw was thin and poor and the ears not very heavy. "Malacca" on the other hand had greatly improved in growth by the flowering stage, giving 2.5 tillers per plant with a good straw. The

strongest straw and finest ears from the first planting were obtained from "Selinsing". The excellent early growth of "Lenggong" was maintained and, although planted two months after the others, it was only three weeks behind in flowering. It gave a remarkably long and strong straw with big, well developed ears.

The actual yields obtained are given in Table I, together with the mean weight of plants two months out of the nursery. Such standard error as occurs between pots is largely due to the fact that plants were removed from a pot to obtain this mean weight and then immediately replanted and, although these plants nearly all reached maturity, their yield was below the mean.

Many of the figures given in Table I may appear of superficial interest but one of the points under investigation is the relation if any of yield to vegetative growth. Taking the figures for weight of plant at two months it will be seen that "Kamunting" was five times as heavy as "Malacca" and four times as heavy as "Selinsing", yet the yield of grain from "Malacca" is slightly higher and from "Selinsing" considerably higher.

On the other hand in the case of "Lenggong" excellent vegetative growth has been maintained up to harvest so that the conclusion is that such early growth may or may not be a criterion of grain formation and it would appear that such growth in some cases partially exhausts the plant.

The comparative growth at two months is shewn in the Plates.

This is well in keeping with observations made in the field where, frequently, early vegetative growth is greatly enhanced by manuring without any corresponding increase in grain.

The mean yield per acre is calculated from the mean superficial growing space of each plant. The area so available was 59 square inches against the standard planting of 144 square inches. This suggests overcrowding. Results however, in another paper in this issue indicate that very little difference occurs between 9 and 12 inch planting, *i.e.* between 144 and 81 square inches so that it might be expected that there is a balance between individual yields and planting distances; the number of tillers per unit area is probably the same.

In any case the fact remains that yields were obtained, at the rate indicated in the Table, for what is not generally regarded as optimum conditions.

On the other hand although soil conditions are not equal to the field it must be borne in mind that the soils had the equivalent of good ploughing when mixed and the actual irrigation conditions were rather better than the field, it being possible to regulate the water at will in a few seconds.

In this connection it should be noted that in no case was the water more than $1\frac{1}{2}$ inches in depth.

Plants were slightly attacked by stem-borers but at so late a stage as to do but little harm,

TABLE I.

Summary of Growth and Yields.

Factor.	No. of row.	Titi Serong Soil.	Selinsing Soil.	Malacca Soil.	Kamunting Soil.	Kuala Lumpur Soil.	Lenggong Soil.	Kuala Pilah Soil.
Mean No. of tillers at 2 months	1st row 2nd „	2.82 2.93	1.22 1.33	2.46 1.50	6.0 5.55	Nil „	6.35 4.80	1.25 1.0
Mean fertile tillers at harvest	1st row 2nd „	2.91 2.56	2.73 2.78	2.77 2.22	3.85 3.55	died at 3 months without growth	4.84	
Mean height 2 months	1st row 2nd „	3′ 0″ 2′ 6″	1′ 6″ 1′ 2″	2′ 6″ 2′ 6″	3′ 0″ 2′ 6″	0′ 5″ 0′ 5″	3′ 3″ 3′ 0″	3′ 3″ 3′ 0″
Mean height at harvest	1st row 2nd „	3′ 6″ 3′ 5″	3′ 11″ 3′ 6″	3′ 2″ 3′ 5″	3′ 4″ 3′ 1″	— —	4′ 4″	
Mean weight in grammes of plant at 2 months	1st row 2nd „	22.4 20.5	10.3 11.5	11.6 6.5	50.8 40.4	1.26 1.0	171.0 168.0 approx.	9.0 10.0 approx.
Mean weight in grammes of grain per tiller	1st row 2nd „	3.87 3.29	4.27 4.42	3.98 3.70	2.56 2.82	— —	5.09 4.70	5.23
Mean weight in grammes per pot		28.98	38.05	27.19	26.28	—	69.23	
Mean yield in gantangs per acre dried padi		403	527	377	365	—	960	
Mean weight of dried straw	1st row 2nd „	576 621	640 759	540 470	604 573	— —	1352	
Mean weight of dry stalk	1st row 2nd „	224 256	273 260	184 186	233 258	— —	500	
Ratio mean grain/straw		0.72	0.815	0.805	0.672	—	0.768	
Ratio mean grain/stalk		1.81	2.14	2.20	1.62	—	2.07	

Differences.

It will be remarked that there is a difference between the yields of the two rows of the same soil in each case. The only difference in treatment was that the first row of each soil was kept free from weeds and algae while the second row was untouched.

While observations were made on growth, examination was made of the soil. In order to arrive at a reliable estimate of differences the examination was made in quintuplicate, the results being submitted to statistical analysis in much the same way as the actual crop yields. Further in order to attempt to arrive at some estimate of soil activity, observations were made on the decomposition of green matter with all these soils under anaerobic conditions. Water was kept flowing over the soil. The gas given off was collected and analysed while measurements were further made of the nutrients removed by this run off water, but results are not yet available.

The figures obtained for the soil are given in Table II. The figures shewn at the head of each column represent the significant difference for that particular nutrient. This only refers to the soil and not to padi yields.

Measurements of change of conductivity of the soil, taken straight from the pots, and after seven days drying out are also given. These measurements are frequently used as an index of fertility.

TABLE II.

Soil	Absolute change of conductivity. x10^{-4}	CaO 0.042	K_2O 0.127	MgO 0.021	C 0.40	N 0.03	C/N 4.5	P_2O_5 0.028	Mean yield per acre in gantangs
Titi Serong	2.62	0.018	0.696	0.215	2.32	0.220	10.8	0.055	403
Lenggong	0.84	0.116	0.528	0.132	2.23	0.200	11.1	0.108	960
Kamunting	1.56	0.050	0.258	0.031	1.59	0.137	11.7	0.104	363
Kuala Pilah	0.49	0.050	0.484	0.022	2.47	0.175	14.1	0.019	
Selinsing	0.39	0.047	0.680	0.113	3.49	0.313	11.0	0.092	527
Malacca	0.18	0.046	0.690	0.033	1.87	0.102	18.5	0.028	377
Kuala Lumpur	0.28	0.021	0.065	0.025	1.13	0.060	18.5	0.015	

Results of statistical analysis shewed that the effect of removing algae, weeds, etc. was only slight, the block variance being 37 while the random variance was 131.

For the usual standard of $p = .05$, difference in yield between any two soil types for significance is 4.75 grms. per pot or 66 gantangs per acre.

It will be observed that "Lenggong" was significantly better than the rest. "Selinsing" was significant over the other three while "Titi Serong" just about reaches significance over "Kamunting" but not over "Malacca".

Any attempt at relating yield with soil analysis is difficult but there seems to be a curious relation between calcium and magnesium content and yield as far as the figures obtained are concerned; this is probably entirely a matter of coincidence.

Examination of the ash content and composition is still in progress and at the moment only the results of analyses of stalk and leaf are available, those of grain and roots will not be finished for some eight weeks more.

For this purpose the stalk, leaves and roots from every three pots were collected separately, dried and "ashed" at a very low temperature. This gave ten separate ashes for each part of the plant for each type of soil. In the case of the grain it was not found practicable to keep separate every three pots and so the whole was bulked and then divided into ten portions for ashing.

The mean analyses for stalk and leaf are given in Tables III and IV together with the significant differences for P = .05.* The mean ash analyses are given in percentages of ash and the Nitrogen and ash percentages are given on dry material.

TABLE III.

Stalks.

Growing on soil from	Ash	Silica SiO_2	Phosphate P_2O_5	Calcium CaO	Magnesium MgO	Manganese MnO	Potash K_2O	Nitrogen N	Yield
Malacca	12.72	51.09	1.394	1.357	0.583	0.234	32.88	0.311	377
Kamunting	9.56	50.21	1.601	1.205	0.607	0.610	33.11	0.260	363
Titi Serong	10.81	58.56	1.707	0.862	1.199	0.466	29.61	0.217	403
Selinsing	12.62	60.63	0.456	1.181	0.689	0.176	27.23	0.370	527
Lenggong	12.74	61.63	2.376	0.965	0.888	0.652	27.41	0.370	960
Significant difference	1.87	3.05	0.365	0.131	0.147	0.043	2.30	0.033	66

It will be seen from these figures that there are very definite differences between the ashes and their constituents for the same padi grown on different soils as far as the stalk and leaf is concerned. No particular constituent, however, is directly proportional to the yield.

* P = .05 means that the likelihood of such results being chance ones is only five per cent.

TABLE IV.
Leaf.

Growing on soil from	Ash	Silica $Si O_2$	Phosphate $P_2 O_5$	Calcium CaO	Magnesium MgO	Manganese MnO	Potash $K_2 O$	Nitrogen N	Yield
Malacca	9.22	77.74	0.670	4.132	0.605	0.202	7.725	0.417	377
Kamunting	10.52	77.81	1.215	3.222	0.535	0.568	5.596	0.371	363
Titi Serong	12.25	81.21	0.847	2.579	1.188	0.735	3.146	0.355	403
Selinsing	14.93	84.27	0.232	2.831	0.422	0.124	4.520	0.355	527
Lenggong	14.14	83.35	0.808	2.489	0.749	0.680	4.104	0.389	960
Significant difference	1.08	2.94	0.120	0.374	0.161	0.096	1.01	0.059	66

The percentage of silica appears to increase with increasing yield while the percentage of potash decreases. The phosphate content of the stalk (the direct feeder of the grain) stands out very decidedly in the case of "Lenggong". On the other hand the consistently low phosphate content in the case of "Selinsing", the next highest yielder, is just as remarkable. There seems to be but little proportion between yield and manganese. Calcium and magnesium shew no relation with yield but shew some tendency for their sum to be constant in the case of stalks.

It remains, however, that differences in the soil do cause differences in the ash constituents even for the same variety of padi though nothing definite can be said until the results for the whole plant are available. There is cause for enquiring whether the percentage obtained for any one constituent can express adequately the part played by that constituent. For the purpose of obtaining a better expression of results the relationship of total constituents to yield, and the relationship of each constituent by itself, is being explored.

Summary.

1. It is believed that the method described of growing padi in irrigated pots for general experimental purposes is a satisfactory one.

2. Yields approximating to those of the field are obtainable while the ravages of birds and pests can be largely prevented.

3. The chemical analyses of the soils indicate that the better yielding soils are definitely richer in plant nutrients.

4. It is shewn that there are significant differences in the ash analysis of both leaves and stalks from the same variety of padi grown on different soils.

5. It is believed that the method will prove to be a very economical one for the purpose of trying out manurial combinations.

IRRIGATION AND DRAINAGE OF PADI AREAS.

Compiled by

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Introduction.

In the Report of the Rice Cultivation Committee which was presented to Government early in 1931 the following remarks appear :—

> "It is clear that the most important question involved in stabilising and increasing the cultivation of padi in Malaya is the provision of better control in relation to water supplies. It should be emphasised that means for getting water off the land are quite as, if not more, important than means for getting it on and that a late season is always a bad season, which is an additional argument for special attention to major drainage without which control of rice planting is impossible ..... We have examined the various aspects of the case very carefully and have come to the conclusion that the only satisfactory solution lies in the establishment of an independent Drainage and Irrigation Department which will be executive in the Federated Malay States and the Straits Settlements and advisory in the Unfederated Malay States.
>
> We consider that the nucleus of this will probably be found in the existing Hydraulic Branch of the Public Works Department of the Federated Malay States and we recommend that this should be developed on the lines of a joint Straits Settlements and Federated Malay States Department with advisory function in the Unfederated Malay States."

Following on this recommendation the Drainage and Irrigation Department was organised on the lines above indicated at the commencement of 1932, and the present writer was appointed Director of Drainage and Irrigation, Straits Settlements and Adviser of Irrigation and Drainage to the Malay States. At the outset a programme was laid down by the Department and work on certain items of the programme was commenced in the early part of the same year. Developments have to a certain extent been handicapped owing to the necessity for the most rigid economy consequent on the financial position of the various Governments concerned. Nevertheless during the intervening period considerable progress has been made and, as the information concerning these works is largely confined to official reports and is not always fully available to the general public, the following account of the principal schemes in progress, together with a statement of the present position, has been compiled for publication in this rice number of the *Malayan Agricultural Journal*. The operations undertaken by the Department up to the present are concerned mainly with the work in the

Federated Malay States and in the Straits Settlements and, in the following pages, the operations in progress and contemplated are described under these two heads.

Schemes in Progress—Federated Malay States.

Perak.

The Sungei Manik Irrigation Scheme :—A large area of potential padi land exists in Lower Perak, near Teluk Anson, on the north side of the railway line, the estimated cost of developing which will amount to probably $350,000. It has been decided to develop this area in stages, and a completed scheme of drainage and irrigation has been carried out for the first stage which is expected to bring into cultivation an area of roughly 5,000 acres. Briefly, the scheme consists of two main irrigation channels one on the northern and one on the southern side of the existing Sungei Manik drain, and entails the clearing of about 400 acres of jungle and of about 200,000 cubic yards of earthwork for the excavation of main canals and distributaries.

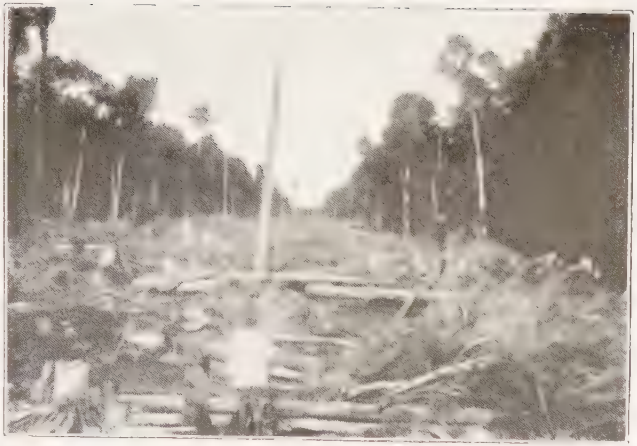
Felling and clearing operations were started in April last year, but, owing to the necessity for economy, unfavourable weather conditions and floods, the work was interrupted on several occasions and in consequence is only now approaching completion. It has been executed at exceptionally low cost.

Pumping Scheme to Irrigate Riverine Areas, Perak River :—A scheme to irrigate padi lands in the mukims of Bota and Lambor Kanan, below Parit, has been approved by Government and an order has been placed for suitable plant to pump water from the Perak River into a canal, 12 miles long, for the irrigation of 12 areas of padi land totalling 2,400 acres on the left bank of the river. The cost of the plant and 16 miles of canal is estimated at $30,000 and it is thought that the water rate from 2,300 acres will be sufficient to pay the cost of maintenance and interest at 4 per cent. on the capital cost as well as depreciation of machinery at 7½ per cent. on the estimated first cost of $8.000.

This scheme is of an experimental nature and on its success depends the progressive expansion of the rice area, which should be possible by establishing additional pumping plant and pumping stations along the river bank. There is a large area of potential padi land in the Perak River valley amounting to about 130,000 acres on the right bank and about 30,000 acres on the left bank of the Perak River.

Selangor.

The Sabak Bernam Peninsula Drainage Scheme :—A scheme for the drainage and bunding of the Sabak Bernam Peninsula has been planned, costing about $180,000. This Peninsula consists of an area of about 28,000 acres, bounded on the north by the Bernam River, on the west and southwest by the Straits of Malacca, while the eastern limits run up in part to the boundaries of European estates and in part to the Bernam River. The whole area

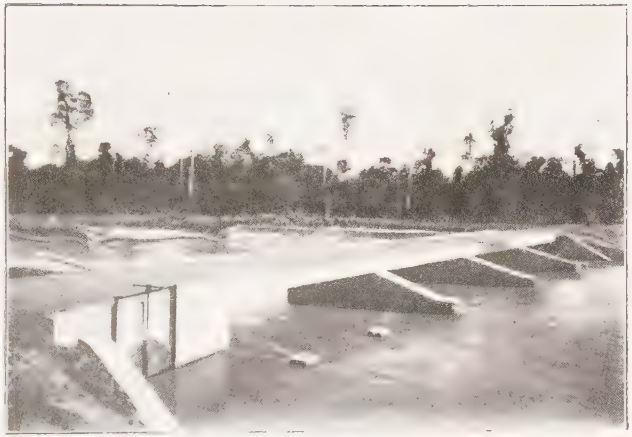


1. Construction of an Irrigation Canal at Sungei Manik.

2. Cutting and Regrading for Drainage, Province Wellesley.

3. After Regrading, Province Wellesley.

4. Irrigated Sawah, Negri Sembilan.



Sungei Bedo. Irrigation Canal Head Sluice.

Chohong. Dam and Gates.

Sungei Blat. Control gate.

The Intake at Sungei Manik.

is very flat, considerably below high water level of spring tides, and would flood twice daily but for the natural protection afforded by nipah and bakau forest along the sea coast. Such protection cannot be relied upon when the development of interior lands becomes extensive, and the scheme now proposed provides for a continuous bund to keep out the sea water, provision being made for the necessary tide gates and also for a system of internal drainage which, with the existing drains, should be sufficient.

Small sums were spent last year in maintaining parts of existing work and on the preparation of an experimental bund. A sum of $50,000 has been provided in the current Estimates, but approval to commence work was only given at the end of August and up to the present about $2,000 have been spent on preliminaries. While this scheme is not exclusively for padi growing it will have a considerable bearing on the adjoining potential padi areas of Panchang Bedina and Sungei Tinggi.

Panchang Bedina Padi Area:—A controlled drainage scheme for an area of approximately 15,000 acres at Panchang Bedina, near Sabak Bernam, on the Selangor Coast has been undertaken by the Department. The scheme includes the construction of 4 main gates and 20 subsidiary gates and involves the felling and clearing of about 566 acres of jungle and about 750,000 cubic yards of earthwork. The area to be dealt with is divided into 17 units and internal gates are provided for the efficient and independent control of the water table in each unit, each gate controlling about 700 acres.

Eleven gates were completed last year and about 200 acres of jungle were felled. The jungle, which is largely nibong, is water-logged and felling operations proved a difficult proposition. Working conditions were very bad during the wet season and difficulty was experienced last year in obtaining labour at the low rates ruling. The contractors are required to employ all Malays who apply for work at rates similar to those paid to other nationalities. Fresh contracts have been let out this year for jungle clearing, earthwork and other items at considerably higher rates and good progress has been made on the construction of the control gates; more than 75 per cent. of the jungle clearing has been completed.

The scheme is estimated to cost $250,000 which will bring the cost per acre to the low figure of $17. The soil has been analysed by the Agricultural Dpartment and has been pronounced to be eminently suitable for the growing of padi.

The Sungei Buloh Padi Scheme:—The scheme provides for the irrigation of a minimum of 700 acres situated adjacent to Mile 15—Mile 18 on the Sungei Buloh road. Water will be led from the Sungei Buloh, which has been raised by a weir at a point on the existing access road to the Sungei Buloh Forest Reserve, by irrigation channels contoured along the sides of the valley. Two gates are fitted to the inlets for these channels one on either side of the valley, and two crossings of tributaries—the Sungei Plong on the right bank and the Sungei Subang on the left bank—are provided for by reinforced concrete flumes.

Sanction was given to commence work in April this year and progress has been satisfactory; the headworks have been almost completed but the construction of irrigation channels has been delayed by land resumption.

Pahang.

Sungei Blat Irrigation Scheme:—A scheme was prepared in 1932 for the drainage and irrigation of about 3,500 acres in the district of Kuantan. The scheme is estimated to cost $25,000 and consists, primarily, of the careful control of the natural drainage of the area by bunds and water gates and, subsequently, the construction of irrigation canals leading from the Sungei Pandan. The proposal entails the construction of about 700 chains of bund and the erection of 15 control gates.

Work was started after the monsoon period this year and is now more than 75 per cent completed; about 400 acres of jungle were given out on temporary occupation licence for felling and clearing for padi.

The soil survey conducted by the Agricultural Department shewed that most of the irrigable area has good rice-growing soil: the area is within 4 miles of the largest town and port of Pahang and there are good prospects for successful padi cultivation.

Kubang Karah Irrigation Scheme:—This is a small scheme also in the Kuantan district, originally projected in 1928, and on which some work was done by the Public Works Department. The essence of the scheme is the damming of a clear water stream—the Sungei Nyor—by a low earthen embankment to provide a reservoir about 60 acres in area, for supplying water to about 80 acres of existing and 200 acres of potential padi land.

Surveys and investigations were made by the Drainage and Irrigation Department in 1932 and a revised scheme prepared which involves the construction of spill weirs and repairs to the dam constructed by the Public Works Department.

Progress on the work has, unfortunately, been interfered with by delay in land resumption.

Minor Padi Areas (Temerloh District):—Several minor padi areas have been opened up in scattered portions of the Temerloh district from a block vote provided for the purpose, and control gates have been built this year for such areas at Sungei Nyak Besar, Mukim Kertau; Paya Didalu, Mukim Sangang; Paya Tuallang, Mukim Perak.

Drainage and Irrigation of Small Padi Areas:—A block vote of $4,000 has been provided for the "Drainage and Irrigation of Small Padi Areas" and is allotted to the various District Officers who collaborate with the Drainage and Irrigation Engineer as to the best manner in which the money should be spent. A sum of $350 is all allocated for a small area at Pulau Jawa (Pekan) to be spent from Headquarters.

Irrigation and Drainage Works for Padi Cultivation :—A sum of $9,000 was spent last year in improvements to existing padi areas throughout Pahang where there are over 30,000 acres of padi land, and such work resulted in the extension of these areas by about 1,500 acres; this work is being continued this year. In the Temerloh and Bentong districts, the schemes are prepared and executed by the Drainage and Irrigation Engineer, while in the other districts, the work is in the hands of the District Officer concerned who acts in consultation with the Drainage and Irrigation Engineer.

Negri Sembilan.

Erection of Dams :—During the current year, dams were built at the undermentioned places, in some cases to replace temporary structures and in others to bring a larger area of sawah under irrigation :—Kampong Solok, Rantau; Kampong Sungei Machang Ilir; Ampang Jeram; Kampong Inas.

A tide gate was also constructed at Sungei Chuah.

Straits Settlements.

Malacca.

Irrigation Scheme at Chohong :—This scheme provides for the irrigation of approximately 672 acres at Chohong adjoining the Malacca/Johore boundary. The original scheme designed by the Public Works Department in 1926 comprised the construction of dams, watercourses and the bunding of the river banks, but the scheme was modified by the Drainage and Irrigation Department at the beginning of last year and bunding was dispensed with, as it was considered that this would be unnecessary since the primary cause of the floods would be removed when the clearing and drainage of the lower reaches of the Kesang River was carried out.

The Chohong and Kesang Rivers form the boundary between Malacca and Johore territory and the approval of the Johore Government was obtained for the construction of the headworks. A gate has been provided at the inlet of the irrigation canal so that the draw off can be controlled and, at all times, half the available water can be used by the Johore Government. The scheme was completed in July this year and is functioning satisfactorily.

The Bachang—Tanjong Minyak Scheme :—The original proposals for the development of the Bachang Swamp and Tanjong Minyak areas were mooted about half a century ago, but it was not until 1931 that a definite scheme was prepared by the Public Works Department. The work was taken over by the Drainage and Irrigation Department early in 1932 when a modification of the scheme was effected; a considerable reduction was made in the estimate while the area to be brought under cultivation was increased from 2,600 to about 3,000 acres.

For the Bachang area, the scheme prepared is one of controlled drainage; this area suffers from severe flooding by the Malacca River and a bund has

been built about 245 chains long running parallel to the Malacca River to prevent such flooding. The Tanjong Minyak area consists mostly of swamp land and is also liable to flooding and the scheme, now in hand, provides for the drainage and irrigation of the area.

These areas are entirely separate from each other, but a combined scheme has been formulated to include both areas, thus reducing the unit cost per acre.

Owing to the financial position it was only possible to make a start on the scheme at the end of 1932, but it is anticipated that construction will be completed by the end of the current year (1933) while there is every prospect that all the land rendered available by the scheme will be shortly taken up and cultivated. The area in question is situated two miles from Malacca town and is readily accessible by road.

Minor Schemes in Malacca:—Minor irrigation schemes have been carried out and paid for from a block vote of $6,000 provided for this purpose at the following places—Chabau, Pulau Sebang, Sempang, Gadek, Alei, Rim.

Province Wellesley.

Revoked Forest Reserve—S. Acheh Coast Region:—Two tide gates are being constructed on two small rivers in the S. Acheh Coast region with the object of reclaiming some 430 acres of land, formerly a forest reserve. This is part of an extensive scheme to bring into cultivation about 4,550 acres of land in Province Wellesley by water led from the Krian Irrigation Reservoir. (Reference to this is made later in this article).

The work also entails the construction of a bund to keep out sea water, but this is being done by the Malay cultivators themselves and, on completion, each worker will be awarded 3 acres on Statutory Grant, no rent being payable for 10 years.

Alma Canal—Outfall Drain to S. Junjong Mati:—Good progress has been made with the construction of a drainage canal to connect with the Alma Drain and Sungei Junjong Mati in P. W. Central. This is expected to bring into cultivation an abandoned padi area of 100 acres. The line of the canal crosses the Bukit Tambun Company's land, but the Company has surrendered the necessary strip of land free of cost.

Clearing Drainage Channels:—During the present year, nearly 62,000 cubic yards of silt were removed from the drainage channels in Province Wellesley and about 1,900 chains (about 24 miles) were cleared at the same time. The sums provided for this purpose are, however, small ($8,300), and larger amounts could with advantage be expended on these operations, which are of prime importance if the conditions of padi cultivation in Province Wellesley are to be improved.

(In Malacca, a vote for a similar purpose amounting to $16,000 is under the administration of the Rural Board).

Dindings.

Padi Area at Sungei Tuntong:—This is the largest padi area in the Dindings at present and a portion of it is liable to flooding each year by sea water. It is proposed to bund an area of about 400 acres, half of which is cultivated, the remainder lying under coarse grass, reeds and shrubs. The cost including three water gates, is estimated at $9,500. A supplementary vote of $1,000 was approved in 1933 to be spent on repairs to the existing bund and gate which are essential for the protection of the area at present under cultivation, and it is hoped that the completion of the scheme will be provided for in the 1935 Estimates.

PROJECTED SCHEMES.

In addition to the works now in hand, designs have been prepared for several schemes, the execution of which, it is hoped, will be carried out in 1934 or later. The schemes of major importance coming under this category are given below —

Perak.

Extension of the Krian Irrigation Works and Additional Supply to the Reservoir:—A scheme has been prepared for enlarging the supply to the Krian Irrigation Reservoir by a diversion canal from the Sungei Ijok via the Sungei Merah. The increased supply of water is required for the needs of the Krian irrigation areas and it will also be possible, by raising the main canal banks, to irrigate the large areas of padi land in the trans-Krian area in Province Wellesley as well as the old forest reserve in the mukim of Kuala Kurau. In all, about 10,475 acres will be brought under irrigation as a result of this project, 4,550 in Province Wellesley and 5,925 in Perak (of the latter some 2,000 acres are already under cultivation) the estimated cost of the proposal is $375,000 which will be shared between the Perak and Colonial Governments. Both Governments have approved the principle of the scheme and a token vote appears in 1933 Colonial Estimates from which certain works mentioned above are being carried out in the S. Acheh Coast region.

Negri Sembilan and Pahang.

Triang Ilir Scheme:—Extensive surveys and investigations were carried out last year on a proposed padi area in the valley of the Triang River on the borders of Negri Sembilan and Pahang and a tentative scheme for the irrigation of an area of 4,500 acres (1,570 in Negri Sembilan and 2,930 in Pahang) was formulated, costing approximately $250,000.

Owing to financial stringency, Government has decided not to embark on this scheme up to the present time.

Malacca.

The Duyong Scheme:—This scheme has been designed to institute controlled drainage over an area of 4,400 acres and is capable of extension ultimately to 5,400 acres. The area to be dealt with lies in the valleys of the Sungei Parit China and the Sungei Duyong including the tributaries of the latter, the Sungei Ayer Molek, the Sungei Ayer Panas and the Sungei Gapam. About 1,740 acres are at present under padi. In order to obtain efficient control over the whole area, all rivers in the area are to be bunded and internal drainage is to be effected through 23 outlets into these rivers. The proximity of the area to Malacca town will facilitate supervision and maintenance of bunds. The scheme is estimated to cost $90,000 or $16.66 per acre (for 4,400 acres, it will cost $20.50 per acre). The soil has been reported upon by the Agricultural Department and has been pronounced to be suitable for padi cultivation. This scheme will be put in hand in 1934.

The Sungei Putat Scheme:—The Sungei Putat valley which is adjacent to the town of Malacca and lies in the water-shed of the old Malacca impounding reservoir, contains 972 acres of which 400 acres are already under cultivation; the upper end of the valley is in blukar and the lower end is subject to periodic flooding from the Malacca River.

The scheme, which will be carried out next year (1934) is intended to supplement ordinary rainfall and to utilise the water from the reservoir if possible; at its lower end, it is proposed to protect the area from flooding by a bund and, generally, the drainage of the whole area is to be improved.

Judging by rainfall returns, it is expected that the impounded water will only be required for two months in the year, *viz*, August and September. A small additional reservoir for storage will be created at the off-take from the main stream. This area is about 46 acres in extent and averages 3 feet deep.

The scheme is estimated to cost $36,000, including land acquisition, and the cost per acre will be approximately $37.

Kesang—Sebatu Scheme:—A tentative scheme has been prepared for the development of the Kesang—Sebatu area and the Merlimau forest reserve, which may be expected to bring about 4,500 acres into cultivation. The scheme depends on the improvement of the Kesang River which will cost about $175,000; this work will benefit about 20,000 acres on the Johore side.

Penang.

Bund etc. at Sungei Rusa:—A bund and water gates are required for the protection of some 1,108 acres of agricultural land at Balik Pulau (about 560 acres of which are under padi) and which are rapidly going out of cultivation owing to damage by sea water. The area is stated to contain some of the best padi land in the whole of Malaya.

The work will be undertaken in 1934; the scheme comprises the construction of a sea bund and two tide gates to deal with drainage, one at S. Rusa and

the other at S. Ayer Hitam. While providing the required protection for the existing padi fields, the scheme prepared by the Drainage and Irrigation Department is expected to bring into cultivation an additional area of about 140 acres.

The preceding account gives a brief summary of the many operations undertaken by the Irrigation and Drainage Department for the improvement and extension of rice cultivation. Insufficient time has yet elapsed for their influence on the output of rice in the Malay Peninsula to become apparent, but there is every reason to believe that, in due course, the effect will be seen in material additions to the production of rice in the Peninsula.

It should be added that in addition to the above projects, the advice of the staff of the Department has been freely given in connection with irrigation and drainage problems arising among cultivators themselves, both direct and also through the agency of District Officers, Land Officers, Penghulus and Agricultural Department Officers. Irrigation Boards and Committees have also been set up in a number of States and Settlements in accordance with the recommendations of the Rice Committee, while the Advisory Committee for Krian Irrigation Scheme, the existence of which is provided for in the Krian Irrigation Enactment but which has never previously functioned, was inaugurated and has proved itself to be a valuable body. On all these Boards and Committees the Irrigation, Agricultural and Lands Departments are represented, while there are also one or more unofficial members.

It may be added that in certain of the Unfederated Malay States, particularly Kedah and Kelantan, appreciable advances have also been made in the introduction of improvements in Irrigation and Drainage in rice areas, and Irrigation Officers are stationed in both these States. The work is, however, at present uncorrelated to that of the Federated Malay States and it has not in consequence been found possible to include an account thereof in this paper.

IRRIGATION DAMS FOR SMALL RIVERS.

BY

B. O. Bush,

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These notes are written as the result of frequent reference to the Drainage and Irrigation Department from District Officers, Agricultural Officers and others for advice and assistance on the subject of damming rivers for irrigation at a minimum of cost or for repairing old temporary dams which have become dilapidated.

The subject is rather more complicated than is generally realised and it is thought that these notes will be of greater service if (even at the risk of repeating the obvious) they deal in detail with the facts underlying the cause of the many failures of damming small rivers by the present accepted methods.

One of the most perplexing problems which confronts the Irrigation Engineer in this country is that of providing a permanent dam, in comparatively small rivers, at reasonable cost.

The demand for such a dam is constantly encountered and the problem is a particularly vexing one because almost everyone (engineers and laymen alike) feels that there ought to be a simple solution.

In almost every case the following factors occur:—

(*a*) The area to be served is small, from 200 to 400 acres.

(*b*) The river to be dammed runs through the alluvial material which is almost the same in all inland valley floors.

(*c*) The catchment area is small and the head waters, where the river runs as a torrent through a sandy bed interspersed by rock shoulders and boulders, are not far distant.

Facts Relating to Catchments.

Taking the catchment area first the chief difficulty is that the smaller the catchment the greater is the run off rate per square mile. In a catchment area of about 100 square miles a run off at the rate of more than 60 cubic feet per second per square mile will occur so seldom that it may almost be ignored. On a small catchment of 3 to 7 square miles, however, a run off at the rate of 300 to 400 c.f.s. per mile is by no means an uncommon occurrence. Thus the range of flow for which a dam must be designed on a small stream is out of all proportion to the range required for a fair sized river.

A small catchment may have a maximum run off of 2,000 c.f.s. and yet the total yield may fall in dry weather to as low as 5 or 6 cubic feet per second.

It is an extraordinary fact that, while in this country we may safely consider that the maximum yield of a 100 square mile catchment will not exceed about 6,000 c.f.s., the rate of flow in perhaps a dozen of the small catchments, which form part of the main catchment and which contribute to a flood, may all exceed one third of the maximum rate for the whole catchment of 100 square miles. The explanation of this of course lies in the time lag for the maximum run off to arrive at any point after rain has commenced to fall. The time lag becomes greater all the way down the river. This interval of time is called the time for concentration.

It will be obvious that the provision of a permanent dam in the Kinta River at Ipoh would be a work of great magnitude, but considerable astonishment is expressed by those who have not examined the problem when informed that a lasting dam for a small stream cannot be installed by depositing a few hundred dollars worth of concrete, though it seems to be a mere trickle compared with the river at Ipoh.

Difficulties of Foundations.

The next difficulty in order of importance is the type of land in which one is usually required to build "small dams" of the type under review. A better way of expressing this would be to say dams for small rivers for, as shown above, a dam for what is normally a small river must be designed to accommodate a run off equal to as much as one third of the maximum known flood of the Kinta River in Ipoh which in the past has caused such extensive inundation in that town.

Valley floors are almost always composed of light clay to a depth of 5 to 10 feet under which is found running sand and coarse material to a great depth. The material under the clay is usually clean and seldom cemented together by fine soil. In most cases water will readily percolate through the lower layer. In many valleys the depth of clay is as little as three feet and special and expensive precaution must be taken to prevent the escape of water under the foundation of the dam.

Damage Caused by Dams.

The natural section of streams of this kind is, almost without exception, never large enough to take the flood discharge of its catchment and, in times of flood, the stream overflows its banks and inundates large areas of surrounding country. This innundation subsides naturally and will return to an unobstructed river channel without much damage, but, since the purpose of a dam is to raise the water level on to its upstream side, it follows that an unnatural and destructive water-fall effect is caused by all water returning to the water course on the down-stream side of a dam. In a permanent dam wing walls and aprons have to be exceedingly large and strong to keep such damage within safe limits.

The destructive water-fall action which occurs just below a dam may to some extent be overcome by providing sluice gates which when open are suffi-

ciently large to ensure that the presence of the dam causes little or no obstruction, but such gates add to the cost and are of course useless if not opened at the proper time. The proper time to open sluice gates is almost always at night, soon after or during an evening's heavy rain; this is because in small catchments the time for concentration is small and the maximum flood arrives at the dam soon after the rain has fallen. The work of gate opening is unpleasant, frequently laborious and in consequence often neglected. As far as the writer knows, the perfect inexpensive automatic gate, capable of performing its function under all conditions, has yet to be invented though many experiments to that end have been tried.

These are the major difficulties of making permanent dams on small streams at economic cost. The area to be served is invariably small because, as has been shown, rivers of this kind will dry up to a flow of five to ten cubic feet per second which of course is only sufficient to irrigate an area of 200 to 400 acres, or even less, if waste of water is permitted.

Seasonal Dams

The temporary dam, therefore, is, in the majority of cases, the only alternative. In India, dams, of what the Malay type should be, are referred to as "seasonal dams" and, for the reasons given later, it would undoubtedly be an excellent thing if such a name could be adopted in this country, because it implies a structure which is put up for a limited period only.

The chief mistake made in temporary dams is the tendency to make them too substantial. The question constantly arises as to how a certain dam may be strengthened by using the inexpensive and limited materials available. The answer almost without exception is that the dam in question is already too strong and has reached its present precarious condition solely because, in the past, efforts have been made to over-strengthen it.

To understand this it is necessary to examine certain properties of the streams of this country. The beds of such waterways are never stable. They are composed mostly of running sand which is continually rolling down from the upper reaches. It is only those who have studied rivers who realise how great this movement of sand and other material really is. When artificial causes of wash such as opening up, jungle clearing etc., do not exist in the region of the source, nature itself continually provides new supplies of sand and gravel by extensive land slips. The scars of these land slips are a familiar sight on almost all the hill sides of Malaya.

Properties of River Beds and Causes of Failures.

Because small rivers are never far distant from the steep uplands of the head waters, their beds are charged with an unusually high percentage of moving material. The bed of a stream resembles a long inclined table down which a layer of sand is rolling continuously. If an obstruction such as a wooden plank

is suddenly put across the table, the sand below the plank continues to roll down, leaving the bare table exposed, and the sand above the plank tends to mount up against the obstruction. Supposing the sand running down the table were one foot deep and a plank say two feet wide were suddenly forced edge wise through the sand down to the table surface, for a few moments we have an exposed width of plank of one foot high above the sand. In a very short time the sand below the plank will roll on and disappear while the sand above will accumulate in depth until it reaches the top edge of the two foot plank.

Supposing the plank were a dam in a river bed, its immediate effect would be to raise the water level by about one foot and it is assisted in keeping upright by support of the sand through which it has been forced. In a very short time however, due to the natural movement of the bed, the plank is no longer holding up one foot of water but two feet of sand and it has nothing on the down stream side to support it.

Now comes the cry that the dam is not strong enough. It never will be. The bed below will always become deeper and the load of sand and water above will always become greater. A step, which is very difficult to support, has in fact been formed in the bed of the river and the height of the step will become greater and greater as time goes on. A large hole in the river bed below the usual Malay dam is a most common sight. The more substantial the dam the greater the hole and the example of the behaviour of water and sand on an inclined plane has been given in detail to explain that the hole is caused not so much by the water-fall over the dam but by the natural movement of the river bed. The only true preventive is to make a small dam over which not only water but sand can easily pass during floods and, when the irrigation season has passed, to pull out the dam and let the river restore itself to normal.

The ideal arrangement of course is to have no dam at all. If the off-take from the river is sited sufficiently far up the valley, water may be intercepted at a level high enough to make a dam wholly unnecessary. It is very difficult indeed to persuade the cultivators to do this.

The writer knows a case where great care was taken in siting an off-take. The river was levelled and the irrigation channel made to enter it at a point where the water level was high enough to fill the channel without obstructing the stream. The work was entirely successful but, in spite of everything, the local cultivators actually put a jungle roller fence across the river below the off-take presumably because they were quite unable to believe that it would continue to function without a dam!

Sometimes of course it is not possible to get far enough up the valley to dispense with the dam entirely but, as a principle, if any temporary dam has to raise the water level by more than 12 to 18 inches, in order to perform its function, the site should be abandoned and another found further up the river.

Against this principle comes the opposition to a channel passing through lands not benefited by the water but this difficulty should not be insurperable.

Suggested Design for a Seasonal Dam.

An excellent seasonal dam may be formed in the following manner, usually at less expense and labour than is often expended annually on attempts to bolster up an old dam where the river has been badly damaged by past mistakes.

A moderately straight length is chosen at a point where the widest section of the river exists. Width is very important because it reduces the depth of surcharge of water over the dam when the stream is in flood. No attempt should be made to follow the favourite method of fixing a solid fence of stout jungle poles across the stream. A row of light, jungle sticks should be driven into the river bed in a line across the river. These sticks should be 1½ to 2 inches in diameter, and at least one foot apart, and should be driven into the river bed until the tops are a few inches below the dry weather water level. At intervals of two or three feet, similar rows of sticks should be fixed. Each row should be quite two feet up-stream of its neighbour and the height of each successive row should be an inch or two only greater than the next row below it. This process is continued until about one chain of river has been treated—say thirty rows. Care must be taken to see that the upstream rows are not too tall. They should not exceed the height of the shortest row of sticks at the extreme down stream end by more than 18 to 24 inches depending on the amount of damming effect required. The next step is to fill the spaces between the sticks with brush wood, wattle, leaves etc. This mat of twigs may be lightly pegged down, if it shows too great a tendency to float away. The mat should be thicker and more dense at the sides to prevent damage to the banks. By depositing the brush wood evenly and closely the water level up-stream may safely be raised by 12 to 18 inches.

The great advantage of working on these lines is that the dam has a large foundation area. Movement of the sand in the river bed will take the form of producing a flat slope rather than an actual step. Anything which can be done to increase the area of the foundation of the dam is all to the good. Any fence-like structure composed of a continuous row of poles is doomed from the start, no matter how large the poles are or how firmly they are driven.

It is not claimed that the dam described above is the only suitable type of seasonal dam but it may be stated with confidence that it covers the general principles necessary for success. If the requirements of a wide crest, a large area of foundation, lightness, cheapness, ease of removal, bank protection etc. are provided for in any other design there is no reason to expect failure.

Reasons for Removing Dams each Season.

At the end of the season every particle of the dam must be removed and this is easily done if the whole structure is properly made of the lightest materials. If a few heavy floods occur while the dam is in action they will probably wash out some of the brush-wood. It is all to the good if this should

happen because the river channel will suffer correspondingly less and the wattle and twigs are easily replaced. It must be remembered that the movement of a river bed is at its greatest during a flood.

Something unpleasant will inevitably happen during large floods if a temporary dam is too substantial, for rivers like steam boilers must have safety valves. The irrigation channel will become hopelessly overloaded and large quantities of sand will be carried into it if the dam remains intact. Sometimes the sand travels far enough to ruin the upper reaches of the planted lands or, at the best, the laborious task of lifting the sand out of the irrigation channel must be met when the flood subsides. If the sand nuisance is not present to choke the waterways, flood damage will often take the serious form of enlarging the irrigation channels until they become large enough for the stream itself and the river forms a new bed, at the same time destroying much of the original scheme of irrigation.

In the Sri Menanti valley for example three or four old beds of the Sungei Sri Menanti may be seen, all of them probably caused by the river being forced by a strong dam to usurp an old irrigation channel for its new channel. Old river beds of this kind are an endless cause of trouble. Irrigation channels have to be flumed to cross them. If they are not very carefully banked off they act as a drain just when they are not wanted to and vast quantities of water are lost in this manner. It is only when difficulties of this kind are encountered that one begins to realise the wisdom of protecting and respecting existing river channels and keeping them in good order.

The removal of the dam at the end of the season should be an easy task but it is absolutely essential, in order that the river may restore its bed to normal, and it will undoubtedly do so if given the opportunity.

These points are stressed because it is known that many of them are quite contrary to the inclination of the ordinary type of cultivator. He invariably chooses the narrowest possible part of the river. He thinks by doing so he will save labour. He selects the heaviest stakes he can get and drives them as firmly as he can into the river bed. The admirable desire to make a good job of work is, in this case, most unfortunate because he is up against a natural force which is rather beyond his understanding. He does everything he can think of to make a temporary dam a permanent one, all to no purpose, and, at the end of the padi season, the structure is forgotten and what remains is permitted to continue to damage the river channel.

Every kampong Malay will admit that it is easy to dam a river for the first time when the site is undamaged. He knows quite well that, with each succesive year, his difficulty will increase. If he can be persuaded to construct a light dam and to remove it thoroughly every year he will always be in the happy state of having an undamaged site to deal with.

DRY PADI IN KELANTAN.

BY

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Statistics of the area of land planted with padi in Kelantan have in the past been given as 147,329 acres but it may not be generally appreciated that of this area 35,073 acres, or roughly 24 per cent., are under dry padi cultivation. The actual figures given are believed to be inaccurate but it is at least probable that the ratio of areas under wet and dry types is correct.

The land planted with dry padi falls into two groups, that habitually under the dry crop and that which may be utilised for either the wet or dry type. The latter forms but a small proportion of the whole and comprises the lower lying dry padi or tugalan lands the choice of wet or dry padi for any particular year depending on the inclination of the cultivator or, in some cases, faith in the Siamese calendar of a 12 year cycle. Generally speaking the fields are flat or slightly sloping and in the latter case wet padi land is found at the bottom of the slope, dry padi land over the main area and the intermediate or alternating type mentioned above in a narrow strip between the two.

Throughout the dry padi areas lots are divided and demarcated by bunds, a fact which is referred to in a subsequent paragraph.

The soil throughout the dry padi lands is markedly homogeneous and, though occasional ridges of slightly sand soil are found, a heavy loam predominates.

In view of the localised nature of the crop it is not surprising to find that there are only some twelve distinct varieties cultivated. The maturation periods of these varieties varies from 173 to 197 days and, though the majority can only be used as dry padis, there are some which can also be successfully planted on wet land. That yields at least approach those of wet padi was shown in a recent trial in which two varieties each gave an average yield for 10 plots of over 350 gantangs (1,925 lbs.) per acre, and the average yield of the entire planted area, including one (wet) variety which gave only 90 gantangs (495 lbs.) per acre, proved to be 220 gantangs (1,210 lbs.) per acre. Such yields are apt to give a false impression and lead to the belief that improvement of dry padi crops will obviate the need for irrigation in many areas. This is not the case, as irrigated padi will give a steady return over a number of years independent of weather conditions, whereas the success or otherwise of the dry padi crop is dependent on a favourable monsoon. Dry padi moveover calls for an amount of labour and care which not all cultivators are prepared to give and which is

greatly in excess of that required to produce a crop of the wet type. The crop however is well worthy of attention and, in order to indicate the difficulties of the cultivator and suggest possible lines of improvement, this article has been written.

In considering the cultivation of dry padi in Kelantan a number of facts must be borne in mind. This State, unlike the western States of the Peninsula, suffers from a marked dry season, which may extend from the middle of February until the end of May, but which varies in duration and severity. This dry season is followed by showery weather in July and August, the showers becoming more frequent until they reach a climax in the monsoon. During the dry season the land bakes so hard that the local plough with a rounded sole and sharp turn on the mould board is barely able to penetrate the soil and the small local cattle, which have to exist on the sparse grazing provided by baked padi fields, are unable to drag the implement effectively.

In preparation for the crop the peasant commences ploughing at the end of June or early July when the land has been softened by rain but has dried out sufficiently to avoid any danger of puddling. The land is turned over to a depth of approximately two inches and in dry weather is subsequently harrowed down. The soil is then allowed to lie for a period of about 10 days when it is said to be "masak." Should rain fall after ploughing the furrows break down and harrowing is unnecessary. These operations are repeated twice more with the appropriate interval between cultivation, the objects being to attain a depth of cultivation of about 3½ inches and to kill weed growth. Finally the land is ploughed and harrowed a fourth time and seed planted in rough lines by dibbling in on same day; subsequent cultivation is confined to weeding which is performed by cutting down the grass with a short knife at varying intervals.

Throughout these operations from the preliminary ploughing to the last weeding the utmost care is taken to avoid puddling the land or packing it unduly.

If the crop is to be a success it is essential that the plants should be well established and some 12—18 inches in height before the land becomes waterlogged. If planting is delayed the plants do not become sufficiently developed before water commences to stand in puddles on the surface, they do not tiller, weeding cannot be efficiently performed, and the crop is poor. On the other hand, once the plants are well established and all weeds removed, the crop is unharmed by an excess of water. Certain varieties, notably the short term and therefore late planted varieties, are less resistant to excessive water than others.

As an important point in the cultivation of this crop is to avoid puddling the soil, it follows that weeding should be completed before showers become a daily occurence; thus it is advisable that the actual planting be completed early in August. This, however, may be a matter of difficulty. If the dry season has been severe and protracted the peasant with his poor plough and draught

animals is unable to commence work until the land has been thoroughly softened by rain and subsequently, owing to the shallow furrow turned by the plough, he has to plough four times to obtain sufficient depth of cultivation. The four ploughings, together with the periods between ploughings, retard planting, until, by the time the crop is ready for weeding, rain is a daily occurrence and weeding inffectual, being actually harmful by causing puddling.

The necessity for four ploughings to achieve sufficient depth of cultivation, and also with the object of eradicating weeds is open to doubt, but this has been the custom for a very long time and the cultivators continue to follow the methods practised by their progenitors.

In considering methods of improvement of yield manuring and seed selection present themselves as the first and most important lines to be followed, while the customary cultural processes may also be improved. As regards seed selection it should be confined to the medium and long term varieties since the short period types induce cultivators to plant late, with the result that weeding cannot be effectively executed and the padi is insufficiently mature to withstand water-logging when rains become frequent.

The observations in this article suggest a number of minor activities covering a wide field which will all tend to improve and stabilize the yield of dry padi and these may be summarised as follows :—

(i) Education of the peasant in animal husbandry, the growing of fodder and grazing grasses to enable his stock to be kept in better condition and to provide food capable of supporting improved stock.
   (*a*) Experiments with better implements.
   (*b*) Devising of means for the provision of better implements.

(ii) The popularisation of imported, light steel ploughs capable of ploughing the land to a sufficient depth in one operation.

(iii) The provision of tine harrows which will have a breaking effect on the soil rather than the compressing effect of the local harrow.

(iv) The provision of tine cultivators to carry out rapidly those functions at present effected by the last three ploughings.

(v) Education of the peasant in mulching and weeding of the crop during dry spells as opposed to the cutting of weeds as commonly practised at present.

(vi) Insistence by Government on early planting, followed by cultivation of the crop.

(vii) The elimination of bunds which hold up rain water and thus tend to spoil the crop and the substitution of drains to remove the water.

RICE MILLING IN MALAYA.

Compiled from Records Existing in the Department of Agriculture.

BY

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Director of Agriculture

and

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Economic conditions, combined with the intensive campaign for the extension of rice cultivation which has been in progress during the past three years, are already beginning to create a state of affairs which requires that attention should be paid to the question of finding markets for the disposal of padi, surplus to the personal and domestic requirements of the growers themselves.

The encouragement of production, coupled with the depressed condition of the rubber industry, has already resulted in increased yields in many districts and there have been considerable extensions in area so that in many localities there is now becoming available for the first time in the history of Malaya, a surplus above the immediate consumption needs of the local population which is available for sale to other areas; in consequence, and unless the policy of stimulation of rice production is to fail, it is necessary that steps should be taken to provide a means for the disposal of such surplus crops at fair and reasonable rates. Amongst the chief difficulties in marketing padi are its bulkiness and the necessity of milling it before it can be used for human food. The bulkiness of padi is reduced in volume by approximately 55 per cent. and in weight by 37 per cent. in milling so that it is evident, that where transport to distant markets is necessary, the padi must first be converted into rice.

Accordingly the question of milling padi is rapidly assuming increased importance and, in order to provide a readily available source of information on the subject, the following brief account of the process of milling padi in its various aspects has been compiled.

In the East the term 'padi' is generally applied to unhusked rice grain and before this padi is fit for human consumption the husks or outer coverings of the grain, which are very tough, fibrous and indigestible must be removed and separated from the kernels. This separation is effected by various methods which mainly consist in causing vigorous friction amongst the grains either by direct pounding or by rapid rotation so that the husks are cracked against a hardened surface. Furthermore, in order to improve the appearance of the husked kernels, which are normally pale-brown in colour, they are usually submitted to some form of polishing effected by further friction which strips

off the buff coloured outer layers of the kernels where the proteins and fats of the rice are mainly situated. The extent to which this polishing is effected is indicated by the whiteness of the rice which is, in addition, frequently 'pearled' to give it the glassy appearance demanded for a high quality commercial product. High polishing is associated with a loss of nutrition since it is found that highly polished rice contains less protein and fat than rice which is under-polished such as that eaten by Malays in their kampongs.

The general sequence of operations in a self-contained commercial mill of the medium or larger type, in which the padi is circulated by mechanical conveyors, begins from a hopper situated conveniently for the loading of padi from the padi store. The padi is then conveyed to the cleaning machines where dust, dirt and empty grains are eliminated, the cleaned padi passing on to the sheller where the husks are separated from the kernels.

Thereafter, the milled mixture is sieved to remove any small broken kernels; the husk is fan separated and collected for use as a fuel which provides the power to drive the mill, while the remainder goes on to the separator from which unshelled padi is returned to the sheller. The husked kernels, which are often called 'brown' or 'cargo' rice, are further passed through the polisher, or whitening cone, from which the bran is bagged, the polished rice frequently receiving a second polishing course before being sieved. The rice is then conveyed through the winnower and grader where it is separated into whole rice, large broken and small broken rice which are bagged separately.

Rice Mills in Burma.

In Burma commercial rice milling is performed by very large mills situated at the ports, with capacities varying up to 500 tons of padi daily, and by smaller mills scattered all over the rice producing areas of the Province, while a considerable amount of milling of domestic supplies is done in hand mills. The large milling companies purchase their padi supplies through brokers who may receive advances from the companies or finance their own purchases. These companies produce 'cargo' rice which is exported to Europe and elsewhere for remilling, or 'white' rice which is exported for direct sales. The smaller mills, of which there are over 500, vary in capacity from 25 to 75 tons of padi per day (50 tons = 20,000 gantangs) and are engaged mainly in the production of 'white' rice for local sale or for export, though a fair quantity of parboiled rice is also milled chiefly for export to India and Malaya.

Many of these small mills, for want of sufficient capital to purchase padi or as a result of speculation, have been forced to cease operations during the existing economic depression. The practice of buying in supplies of padi, milling it, sending the rice to Rangoon for sale and depending on the proceeds of the sale to purchase further padi supplies has proved a losing game on the falling markets which have been experienced in the past few years. On the

other hand, the purchase of supplies of padi against definite demands has led to payment for padi on rising markets so that, in times of rapid fluctuation in price, millers have sometimes experienced losses in the year's working.

Many of these mills are hired out by the season to brokers and under existing economic conditions these hired mills have fared best in recent years.

Milling in Siam

Formerly milling in Siam was conducted entirely by very large mills to which padi was transported from all over the country but within the past 10 years, small mills have sprung up 'like mushrooms'. This change has been ascribed to an effort on the part of millers to overcome transportation costs, the rice being sold for local consumption as well as to big millers and dealers in Bangkok. In the early stages, these mills undoubtedly proved profitable but under existing conditions many have experienced losses and closed down.

Exclusive of Bangkok districts, there are over 700 small mills in Siam of capacities varying from 3 piculs of rice per hour up to 28 piculs, the majority being of 6—10 piculs in capacity. Moreover the quality of the product of these mills has been claimed as being equal to that of the large mills in Bangkok.

Native Methods of Milling in Malaya.

The native methods of preparing rice from padi suit the economic conditions in areas where little or no surplus padi is produced, since, at harvest, scarcity of labour which is keenly felt in all large padi growing districts renders it impossible to convert all the harvested padi into rice within a short time. In consequence the padi is stored as such and milled later at leisure according to immediate requirements. This procedure has the double advantage that stored padi retains its flavour better and is less subject to pests than stored rice.

The Malays use two types of mechanical contrivance in milling their padi. In the commoner type the padi is pounded in an enclosed space while in the second type the husks are split by friction between revolving surfaces. The commoner type is known as the "Lesong" of which there are 3 forms designated the "l. tangan", the "l. kaki" and the "l. ayer" according to whether hand or foot or water power is used respectively. These domestic mills are so common that detailed descriptions are superfluous, but it may be stated briefly that, in principal, their action depends on friction between the grain caused by pounding with a hard and heavy implement.

Using the "lesong tangan" or the "lesong kaki" a Malay woman can mill approximately 3 gantangs of padi within an hour, and these types of "lesong" are so simple in design that they can readly be made in the "kampong".

The "lesong' ayer" is identical with the "lesong kaki" except that arrangements for harnessing available water power are installed in addition and frequently this type of "lesong" is worked as a battery of 4 or even 6 machines.

The cost of a "lesong ayer" depends largely on a ready supply of water power, while each unit in a battery is capable of milling 6 to 7 gantangs of padi in an hour.

Usually in all these forms of "lesong" the padi is hulled, winnowed roughly and hulled a second time before the final winnowing, while the percentage of broken rice depends on the age and condition of the padi and on the care exercised by the operator.

The second type of native mill is known as the "Kesaran" in which, of two grinding surfaces similarly constructed of "bakau" chips sunk into puddled and hardened clay, the lower one is fixed while the upper surface is pivoted and can be revolved by hand power with the aid of a simple mechanical device. The "Kesaran" when worked by an energetic Malay can mill 20 gantangs of padi per hour and, if the padi is in good condition, a high grade of rice is produced.

This type of mill costs about $25 and can mill some 4,000 gantangs of padi before the grinding surfaces need to be renewed.

In addition to the native type of mills already mentioned cattle driven mills are in use in a few places. In principle, these consist of a revolving beam which pounds the padi placed in a circular trough of some 12 bags capacity, but the method is rather slow although a good product is obtained.

In winnowing rice the Malays frequently make use of the breeze to blow away the hulls and bran from the milled mixture as it is poured from a height of about 6 feet. More often, however, this operation is skilfully performed by using the "niru", a wide shallow basket, with a rim about one inch deep, in which the milled mixture is dexterously rotated to work the offal to one side from which it is ejected by a smart jerk of the wrist. In some of the larger padi producing areas the "pengipas", which consists essentially of a box in which a fan is rotated by hand so as to create a stiff breeze, is used. The milled mixture is poured slowly through the artificial breeze which effects a separation of the rice from the chaff very efficiently.

Introduced Methods of Milling—Small Milling Units

When imported rice prices were higher efforts were made amongst estates, situated in areas where surplus padi was normally produced, to induce them to install small milling plants and to purchase padi for milling under estate supervision.

While these efforts had in view the provision of good rice for estate labourers, at cheaper rates than those current for imported or commercial rice, their main objective was the creation of competitive padi buying for the benefit of the cultivators, who up to that time had suffered severely at the hands of middlemen buyers of padi for supply to Chinese owned mills. Resulting from these efforts several estates purchased small power mills while one independent commercial mill was established in Province Wellesley. Some of the estate mills functioned with eminent satisfaction for several years, capital costs

being recovered and handsome sums being saved for the benefit of the coolies concerned, who also benefited by obtaining their rice, in full measure, at materially lower prices than those prevailing in the local shop.

Unfortunately, in the last few years the influx of abundant supplies of very cheap rice from Burma and Siam has nullified the good work done by estate milling units, which have been forced to close down so long as such cheap imported rice tends to make local estate milling unremunerative. The mill which gave most satisfaction was that of the 'Engleburg' type which originated in America but which has since been imitated in England with various added improvements, by several makers, under different names, the 'Planters' Mill', the 'Ajax', the 'British Rice Huller', the 'McKinnon' and others.

This type of mill occupies little space, is easily erected, simple in its adjustments and the size generally used only requires 6—8 h.p. to drive it efficiently, while the rice produced (parboiled) is of excellent quality.

In principle, this type of mill consists of a ribbed metal cylinder which is made to revolve rapidly within an enclosed space into which the padi is fed. The padi is hulled as it circulates with the cylinder by being struck on a fixed 'hulling bar' of hardened metal.

The output of these mills was found to be about 60 gantangs (480 lbs.) of clean rice per hour when, as in most cases, the padi was put through the mill twice, which indicates that the main defect of this type of mill is that it does not separate the milled from the unmilled kernels nor is the bran separated from the husk.

In one case, where white rice was produced, a separating arrangement was added to the mill by which the milled mixture was separated into good and broken rice, chaff, bran and unmilled kernels, the latter being remilled. In this instance broken rice and bran were sold at fair prices, whereas usually no separation of these products was adopted and consequently their value was lost. Milling costs with these types of mill were computed at 1.2 cents per gantang of rice, exclusive of depreciation and supervision on one estate, and at 1.4 cents on another estate, the padi in each case giving 44 per cent. of rice by volume measurement.

Most of the estate mills produce parboiled rice only, since Indian coolies prefer parboiled rice to white as it keeps better and is more easily cooked and, incidentally, is more nutritious than polished rice. The parboiling process involves soaking the raw padi for 24 hours, preferably with at least two changes of water, and then heating to boiling point for 20 minutes after which the padi must be thoroughly dried before milling. The parboiling of the padi tends to make it swell slightly and hardens the kernels so that breakage in milling is reduced.

Local Large Milling Units.

There are no really large mills in Malaya in comparison with the big mills of Burma and Siam, the majority of the local large mills having a maximum capacity of under 250 bags of rice per day. All the commercial mills in this country are situated in or near the large rice producing districts of Kedah, Province Wellesley, Penang and North Perak and, with the exception of two Government mills, they are all owned by Chinese.

In Kedah there are 21 mills, of which only 18 have been worked regularly in recent years, and of these 3 are large mills while 15 are of medium size having capacities of 3—4,500 gantangs of padi per diem. The bulk of the output from the mills in this State is polished white rice, since Malays do not eat the parboiled product.

In Province Wellesley there are 8 mills of which only 6 are operating. One of these is a large mill of 22,000 gantangs daily capacity, 4 are of medium size and one is quite small. In this area 80 per cent. of the output is parboiled rice to be consumed by Indian labourers.

In Penang there are 11 mills, 4 of which do not operate at present, 4 are small mills, one is of medium size and 2 are large mills while 75 per cent. of the production is parboiled rice.

In North Perak there are 3 large mills of which 2 are owned by the Government; the larger of these has not been in operation for some years owing to shortage of padi supplies. Approximately 90 per cent. of the output of these mills is parboiled rice. In addition there are several small power mills on estates in the Krian district, but none of these is operating at present for reasons already mentioned.

All the smaller mills in the country usually obtain their entire padi supplies from local cultivators, but the medium and larger mills purchase not only local padi but supplies shipped from other areas and, in exceptional years, have even imported padi from Burma and Siam.

Additional Observations.

In its present stage the problem of small and medium power milling in Malaya is urgently in need of further investigation and experiment with particular reference to the most economic and efficient type of mill and milling organisation to suit the needs of newly opened padi areas. Wherever a padi mill is designed to afford an outlet for surplus padi production, provision for storing large quantities of padi in connection with its operation must be considered, since cultivators usually require to sell all their surplus padi within two months of harvest in order to raise cash to pay for rent and other necessities.

In existing padi areas domestic storing arrangements are inadequate for retaining surplus padi and this state of affairs would certainly be still more keenly felt in newly opened areas; consequently, unless padi cultivation becomes

a more profitable occupation than it is at present, there is little prospect of any mill being successful unless abundant storage accommodation is made available.

This problem indicates the need for investigation of the possibilities of bulk storage of padi at mills, in contrast to storage in bags as practised at present, and it would seem that, if due precautions are taken in regard to the moisture content of the grain, bulk storage should give satisfactory results. In point of fact, the Malays normally store their own domestic padi supplies for the year in bulk in large wooden boxes or stores specially constructed of bark or other materials and protected from rain and rats, and though such stores rarely exceed some 2,000 gantangs of padi in capacity, they indicate the possibilities in the direction of bulk storage. Further information on local padi storage is given in the article by W. N. Sands in this number.

Another problem which requires investigation is that of artificial drying, as opposed to sun drying which is precarious and excessive in its demands on space and on labour; there does not appear to be any material reason why artificial methods cannot be as successfully applied to padi as they are to maize and wheat in large producing countries.

The absence of such methods of drying padi in large rice producing countries can only be attributed to the fact that in most of those areas harvesting is conducted, normally, in very dry weather so that the padi is already sufficiently dry before purchase, but in this country the weather is often unreliable and the atmosphere is always fairly moist.

A combination of artificial drying with bulk storage would reduce handling costs and considerably ease the question of drying and storing space in the construction of milling units.

Another point in connection with the establishment of new mills is that the purchase of padi for milling requires an efficient and experienced buying organisation, for it is a business which is open to serious abuses which are liable to lead to material losses.

In existing areas padi purchase is carried on mainly by middlemen on a commission basis with fairly satisfactory results. There are a few areas, however, in which Co-operative Societies engage successfully in the business of padi purchase and there is immense scope for further development in this direction which has much to commend it.

Finally, the importance of grading grain both before and after milling must be stressed since quality depends very largely on the amount of attention which is given to this operation and without the adoption of high grading standards locally milled rice cannot compete with the imported article.

THE CHARACTERISTICS OF MALAYAN MILLED RICE.

BY

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While local rice production is being encouraged by every possible means, the question of the suitablity of locally produced rice must not be overlooked. It is patent that if the industry is to flourish, locally produced and milled rice must be able to compete in quality as well as in price with the imported article, since it is becoming increasingly evident that the Chinese and Indian rice eating population will not agree to the substitution of an inferior home-grown article for the imported one to which they are accustomed. This applies with particular force to the Chinese section of the population who demand rice of the highest quality.

Lack of evidence regarding the quality of the produce of local mills in comparison with imported rices indicated that a survey was desirable and, in accordance with the suggestion of the Director of Agriculture 34 representative samples were obtained from practically all the larger mills in the country through the Agricultural Field Officers while, for comparison, 20 commercial samples of imported rice were obtained from local stores. A preliminary examination of the samples showed that a good product can be milled locally, a few samples being of quite good quality. The samples were submitted to tests for moisture content, percentage of broken rice, volume-weight ratio, uniformity of grain, cleanliness and colour; the results are shown in the Table below which was compiled with the assistance of the Agricultural Chemist who analysed the samples for moisture contents.

As regards moisture content, little comment is necessary since, with four exceptions, all the samples were sufficiently dry in comparison with similar samples of imported rice. This is shown in Table II in which the figures of Table I are summarised. Table II also shows that there is little variation in the volume-weight ratio, the mean weight per bushel for all rice groups being 64.9 lbs.

In the white rice groups the percentages of broken rice show extremely wide divergence ranging from 1 per cent. in Siam No. 1 rice to 31.1 per cent. in Rangoon rice. Local white rice compares very favourably with Rangoon white in this respect, but both these classes differ significantly from the Siam rices which are practically unbroken.

TABLE I.

No.	Type of rice	Quality	% moist	% broken	Grain type	Clean-liness	Colour
1	White Rice	1	11.2	52.5	mixed	clean	yellow
2	ditto	1	10.4	13.6	mixed	dirty	yellow
3	ditto	1	11.0	19.2	little mixed	clean	yellow
4	ditto	1	11.4	31.5	very mixed	clean	yellow
5	ditto	1	10.2	18.8	mixed	clean	yellow
6	ditto	1	11.5	4.8	little mixed	clean	yellow
7	ditto	1	12.1	22.8	little mixed	clean	yellow
8	ditto	1	11.0	23.2	very mixed	dirty	yellow
9	ditto	1	11.0	21.7	little mixed	clean	yellow
10	ditto	1	11.4	7.6	little mixed	clean	yellow
11	ditto	1	12.9	19.4	pure	clean	yellow
12	ditto	1	13.2	5.2	pure	clean	yellow
13	ditto	1	10.5	16.9	mixed	clean	yellow
14	ditto	2	11.6	20.2	very mixed	clean	yellow
15	ditto	2	10.6	21.1	little mixed	clean	yellow
16	ditto	2	10.0	24.9	mixed	dirty	yellow
17	ditto	2	11.5	19.0	mixed	dirty	yellow
18	ditto	2	9.8	26.5	mixed	dirty	yellow
19	ditto	2	11.3	23.0	very mixed	dirty	yellow
20	ditto	2	9.8	32.9	little mixed	clean	yellow
21	ditto	2	10.6	19.1	little mixed	clean	yellow
22	ditto	2	9.7	21.3	very mixed	dirty	yellow
23	Siam Rice	1	9.0	1.8	pure	clean	white
24	ditto	1	9.9	0.1	pure	clean	white
25	ditto	1	10.0	1.0	pure	clean	white
26	ditto	1	10.9	1.2	pure	clean	white
27	Siam Rice	2	10.2	1.8	pure	clean	white
28	ditto	2	8.6	1.4	pure	clean	white
29	ditto	2	8.8	2.9	pure	clean	white
30	ditto	2	9.8	1.5	pure	clean	white
31	Rangoon White	1	10.3	22.4	pure	clean	white
32	ditto	1	11.3	21.4	pure	clean	white
33	ditto	1	11.1	26.3	slightly mixed	clean	white
34	ditto	1	9.9	25.9	pure	clean	white
35	Rangoon White	2	10.8	33.6	slightly mixed	dirty	white
36	ditto	2	11.8	18.1	slightly mixed	clean	white
37	ditto	2	10.8	36.1	mixed	dirty	white
38	ditto	2	11.3	36.8	slightly mixed	dirty	white
39	Local Parboiled	1	8.4	13.1	mixed	clean	brown
40	ditto	1	9.7	20.8	mixed	clean	brown
41	ditto	1	9.6	8.4	very mixed	clean	brown
42	ditto	1	10.1	12.5	mixed	clean	brown
43	ditto	1	9.5	8.2	mixed	clean	brown
44	ditto	1	12.8	17.4	very mixed	clean	v. brown
45	ditto	1	10.1	9.7	mixed	clean	brown
46	ditto	1	9.6	7.6	pure	clean	v. brown
47	ditto	1	9.9	2.8	little mixed	clean	brown
48	ditto	1	9.5	9.8	little mixed	clean	pale
49	ditto	1	9.6	10.3	little mixed	clean	brown
50	ditto	1	8.5	14.6	little mixed	clean	brown
51	Rangoon Parboiled	1	9.2	8.6	pure		
52	ditto	1	11.5	7.2	little mixed	dirty	brown
53	ditto	1	10.0	7.1	pure	dirty	brown
54	ditto	1	8.9	12.2	pure	dirty	brown

TABLE II — Summary of Table I.

Type of rice	Quality	No. of samples	Per cent. Moisture	Per cent. Broken	lbs. per bushel
Local white ...	1	13	11.4	19.8	64.9
ditto ...	2	9	10.5	23.1	64.9
Siam White ...	1	4	10.0	1.0	64.6
ditto ...	2	4	9.2	1.9	64.4
Rangpon White ...	1	4	10.6	24.0	66.5
ditto ...	2	4	11.2	31.1	65.3
Rangoon Parboiled ...	1	4	10.0	8.8	64.3
Local ditto ...	2	12	9.8	11.3	64.6

The standard set by the Siam rices indicates uniformity in type of grain, careful milling, grading and cleaning, so that the product, consisting of uniform grains, being free of dirt and white in colour, is attractive in appearance compared with other rices.

On the average, No. 1 quality local white and No. 1 Rangoon white rices are fairly clean but the second quality in each of these classes is distinctly dirty. All the local white rices are inclined to be yellowish and appear to be undermilled by comparison with the Siam rice which is white and, though from a nutritional point of view this may be an advantage in local rice, from the view point of market value it constitutes a serious drawback which can only result in reduction in price, at least as far as the Chinese section of our population is concerned. Variation in the parboiled group of rices is much less marked than with the white rices, local parboiled having 2.5 per cent. more breakage than the Rangoon product, though all the local parboiled rices tend by comparison to show a darker colour than the imported article, the colour being probably due to undermilling or to some defect in the parboiling process.

In both the white and parboiled groups local rice appears to be derived from mixed padi as compared with imported rice in which mixture of types of grain is much less apparent. This is more or less what must be expected when due regard is given to the different conditions under which the padi is grown. In Siam and Burma, areas are immense and rice cultivation has been the main occupation of the people, as well as their chief industry for very many years, so that standards have been achieved such as do not yet exist in Malaya.

In Kedah and the north of Province Wellesley some of the mills, situated in the midst of large padi producing areas, turn out good quality marketable rice so that it is evident that a high grade article is not impossible of attainment.

Thus, samples Nos. 6, 10 and 12 in Table I are of good marketable quality by comparison with the majority which lack uniformity in grain size and show a high percentage of broken rice. In the mills which produced these samples it has been reported that the padi is graded prior to milling, that particular attention is given to the milling processes, and that the final product is carefully separated to reduce the percentage of broken rice to a minimum and thus ensure a high grade No. 1 quality rice.

If similar attention in milling, and in particular to grading, could be given in all local mills the quality of the product would be greatly enhanced. At the present time, the considerable demand for cheap rice has probably influenced the quality of local rice detrimentally.

THE STORAGE OF PADI IN KEDAH.

BY

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There is an old established custom among Malay padi-planters to store sufficient padi to supply food for home-use over a period of at least one year. During the past three seasons of bountiful crops increased attention has been given in Kedah to the storage of padi, in excess of domestic requirements, and which would normally be sold to millers, and others, as soon as possible after harvest.

The rush to sell padi at harvest time has in the past led to lower prices and, when padi was assembled in large lots at convenient centres, the current depressed price was paid, but if padi was purchased in small scattered lots the price was still further reduced by about 10 per cent., this was due to the extra cost of collection and transport, and also to some extent to the newly reaped padi being insufficiently dried.

Prices, as a rule, were considerably higher from planting time onwards, say six months or so after harvest. In 1933, for example, the price paid for padi by Chinese millers in August was no less than 50 per cent. higher than in January. The fact that higher prices could be expected if padi was kept in storage for some months following harvest led to efforts being made to form societies, or to use the existing Co-operative Societies, for the purpose of storing padi and financing planters who sent padi for storage.

Large quantities of padi are generally disposed of, prior to harvest, to persons from whom the growers had obtained cash, or goods. This padi is known as 'padi kuncha' and the usual rate of advance of cash, or goods, for such padi in 1933, was $4 to $5 per kuncha (160 gantangs), and under the agreement one kuncha of padi had to be handed over at harvest for every $4 to $5 advanced. The system is a pernicious one which the Co-operative Societies and others are doing their best to counteract. The storage schemes which have been started and are now described will, it is hoped, render much assistance in future in this direction.

Smaller amounts of padi are also sold in the villages, but the bulk of the surplus, in the absence of ready cash or storage facilities, has to be sold early to local Chinese millers or to middlemen for shipment to Penang and elsewhere.

The Storage Societies which hold padi for six to nine months whilst waiting for a more favourable market can be grouped under two heads :—

(*a*) those arranged by private enterprise and

(*b*) those worked in connection with rural Co-operative Societies and confined to members of these Societies.

A large Galvanised-iron Granary.

Small Galvanised-iron "Jelapang"

JELAPANG BUILT OF LOCAL MATERIALS.

JELAPANG OF LIGHT CONSTRUCTION.

The working details of each group are similar in most respects. Briefly stated, they are, that any quantity of padi can be sent for storage, except 'padi kuncha', referred to above, which is refused. All padi must be thoroughly dry, clean and sound and of a good milling grade. The grade preferred, because it realizes the highest prices, is the medium long Radin type such as produced by the varieties 'mayang ebus', 'reyong', 'Radin China' and 'to' seman'.

Storage facilities are arranged for by the Societies, either in their own or rented stores. For every 160 gantangs (one kuncha) of padi sent for storage, 16 gantangs (one naleh) in addition are contributed to provide for loss in weight and volume and also to cover the proportional cost of the rent of the stores and handling charges.

If the members of a Society own a store, or stores, 8 gantangs only ($\frac{1}{2}$ naleh) are contributed for depreciation, but for non-members the full rate is charged. Should any member require an advance against his padi in store for the preparation and planting of his land for the next crop he can obtain the advance based on current price which this year was at the rate of $10 per kuncha stored. Should he be a member of a Co-operative Society and his padi sells for more than the sum named, his account is credited with the proportional share of the profits.

At times private Storage Societies do not make a charge for depreciation, but arrange for storage, sell at what is considered to be an opportune time and divide the proceeds, *pro rata,* among the contributors of padi, less the cost of working expenses.

It will be realized from the foregoing that the organisation and working of storage schemes are quite simple in operation. It is necessary, however, to collect accurate information before, or at harvest, as to the quantity of padi to be stored, either temporarily or for several months. Unless this information is available, considerable difficulty may be experienced in arranging accommodation. Also, it is essential for success that members must be loyal to their Society and refrain from demanding the return of their padi once it is stored. In special circumstances, however, for example when padi is urgently required for sale in a village owing to a shortage of food, it may be released.

The chief types of stores are known as 'jelapang' and 'kepok' respectively; the former is usually a fairly large, solidly built structure and the latter a small one of much lighter construction.

All padi is stored in bulk no matter what type of store is used.

Description of 'Jelapang'.

The 'jelapang' type is usually a rectangular, oblong granary raised on posts 2 to 3 feet from the ground. The posts may or may not be set in concrete. The timber used in construction is generally 'meranti', 'chengai' or 'tembusu',

the latter being preferred on account of its very durable qualities. The floors are of wood and the walls of galvanized-iron sheets, planks, or closely interlaced split-bamboo.

The span-roof is covered with galvanized-iron, or 'attap'. The single door is usually composed of loose planks placed horizontally above each other and removable vertically and singly when padi is being dealt with.

When galvanized-iron is used for the walls the inside of the building is lined with boards, or mats, prior to filling the store with padi. There is no outside grain-door at the base, so, necessarily, all unloading is done from the inside and from the top of the heap.

Plate I, No. 1 shows a large galvanized-iron granary 30½ feet long, 15½ feet wide and 10 feet high from floor to wall-plate. This building will hold from 30,000 to 40,000 gantangs of dry padi. The cost of the store could not be ascertained.

A smaller store, also built of galvanized-iron, is shown in Plate I, No. 2. In this, the galvanized-iron sheets are placed inside the supporting uprights and cross-beams. The measurements of this store are 8 feet long, 5 feet 6 inches high to the wall-plate and 5 feet 5 inches wide. This was built at a cost of $80 and will hold about 1,900 gantangs of grain.

The commonest type of 'jelapang' is that built of wood with interlaced bamboo walls and an 'attap' roof. The gable-ends of the roof are protected from the weather by screens made of planks, 'attap', or 'bamboo'. The bamboo used for the walls is the 'buloh duri' (*Bambusa Blumeana,* Schule). This bamboo is also employed for the small cylindrical store known as 'kepok' and can withstand the attacks of insects and rats better than any other species. It also, has the advantage of being more durable.

The 'jelapang' shown in Plate II, No. 1, is 13 feet 8 inches long, 8 feet 5 inches wide and 5 feet 8 inches to the wall-plate. The cost was estimated at $150 and it holds between 4,000 to 5,000 gantangs. Except for the renewal of 'attap' every 7 or 8 years, it is said that the store can last for at least 50 years.

Plate II, No. 2, shows a store of similar type, but of cheaper and lighter construction; this is 12 feet long, 6 feet 5 inches wide and 5 feet 6 inches to the wall-plate. This type holds about 3,000 gantangs of padi. Its cost was $60 and it is expected to last for 30 years or more.

As both large and small 'jelapang' are built along similar lines, there is no need to describe others of different dimensions.

The 'jelapang' constructed of wood, bamboo and 'attap' is favoured on account of its low cost and also because the materials required for its construction can be readily obtained locally.

Only when the stored padi is insufficiently protected on top do losses occur on account of pests, but these losses are small. There is, naturally, some loss in weight which varies with the length of period of storage, but this was found to be about 2 per cent. in one large lot of 85,000 gantangs stored in 'jelapang' for 9 months in 1933.

SMALL STORE WITH TWO BINS (KEPOK)

SMALL STORE WITH THREE BINS (KEPOK)

Kepok.

The cylindrical bin known as 'kepok', is the common family grain-store, and it often forms a useful adjunct to the 'jelapang'. The 'kepok' is constructed of wood and split bamboo with an 'attap' shed, or span roof. The bamboo used is the 'buloh duri' referred to above. The bin is of light construction throughout and can be readily transported from place to place if necessary. From one to three bins are assembled under one shed.

In Plate III, No. 1, where two 'kepok' are shown under one roof at a height of 2 feet above ground; each bin is 12 feet 4 inches in circumference, 3 feet 5 inches high and can hold 250 gantangs of padi.

In Plate III, No. 2, the circumference of each of the three bins is 18 feet with a height of 4 feet, and each can contain 640 gantangs of padi.

A 'kepok' made of interlaced bamboo, with boards at the base, costs from $3.00 to $4.00 according to size. In some cases split bamboo covered with padi straw is used for the floor which reduces the cost of construction still further. The light covering shed built of poles and 'attap' costs about $2.00 per 'kepok'. These small stores last from 8 to 10 years.

It will be seen that satisfactory padi stores can be readily constructed of local materials at small cost and large quantities of padi stored in them successfully for several months: there is, therefore, no reason why a considerable extension of padi storage in villages and small towns, should not be undertaken for the benefit of local padi planters.

Quantities of Padi Stored by Societies in 1933.

It was not possible to obtain complete information concerning the amount of padi stored for some months and afterwards sold, but the following details of padi stored by one large, private Society and seventeen, small, rural Co-operative Societies in 1933 are of interest and serve to indicate the lines along which storage schemes may be profitably developed.

In the Kota Star district a private Society, with over 600 members, stored and sold 85,600 gantangs (38.2 tons) of padi. The sale price was 7½ cents, per gantang, as against 5 cents per gantang offered at harvest.

Seventeen rural Co-operative Societies undertook storage for their members, and 513 members contributed 83,200 gantangs (37.1 tons). This padi was sold some months later at market price.

Considerable quantities of padi are often stored by private owners, but only people who can afford to wait for better prices are able to do this, whereas the raiat can rarely be sure of obtaining full market value for his padi unless he can store it with a properly organised Society or Association of growers.

Acknowledgment.

I am indebted to the Assistant Principal Agricultural Officer (H.H. Tunku Yacob) and the Registrar of Co-operative Societies (Che Abdul Rahman) for the information supplied concerning the storage of padi by Societies, and to Mr. N. H. Sands for the photographs illustrating this article.

MALAYAN PADI COMPETITION.

BY

F. W. South,

Chief Field Officer.

For many years padi classes have formed an important section at District Agricultural Shows and at the Annual Exhibitions of the Malayan Agri-Horticultural Association. The objects of the padi classes at the Shows were to stimulate interest in padi planting and to increase the production per acre by encouraging the planting of high yielding types of padi.

Exhibits in the past have consisted of small samples of padi, one quart each, without any attendant information regarding the size of the holding on which it was reaped or the yield obtained. These exhibits were sent in large numbers to District Shows and in even larger numbers to the Annual Exhibition. It was felt, as a result of experience, that this system did not provide the best means of progress and enabled, as had actually occurred, a small plot of padi grown in a school garden to receive the highest award for padi in Malaya.

The Director of Agriculture drew attention to this position in a memorandum submitted to the Committee of the Malayan Agri-Horticultural Association and to officers of the Field Branch of this Department. He pointed out that the points which required to be taken into consideration were :—

That samples sent to the Annual Exhibition should be larger in size.

That they should be fewer in number and should be the result of some preliminary selection.

That they should bear some relationship to the area cultivated and the yield obtained.

He suggested that one way of overcoming the existing difficulty would be an organisation by means of which the Annual Exhibition should represent the culminating point of an all Malayan Padi Competition. He then gave the following outline of the type of organisation which he contemplated.

In each district the District Officer should be asked to arrange in conjunction with the Agricultural Field Officer to collect entries for the competition. This could be done by mukim, the Penghulu of each mukim being in charge of the collection of entries. The entries would be completed by a certain date and then there would be held in each district a padi show at which each competitor would be required to display at least 4 gantangs of padi, each sample to be accompanied by a statement of the area on which the padi was cultivated and a certificate of the yield obtained given by the Penghulu. Such District Competitions could be held in conjunction with local agricultural shows where they are held, but if no general show takes place a special padi show could be arranged.

As the result of each district competition, the best samples from each mukim would be selected for despatch to the Central Show in Kuala Lumpur, each sample as before being accompanied by the certificate as to acreage and yield. In addition the samples from each district should be accompanied by a certificate from the Agricultural Field Officer stating the average yield of padi for the whole of a particular district as revealed by departmental computation. It seems not improbable that in order to make the system a success additional awards would be required for the District Padi Shows. These awards might take the form of either bronze medals or certificates either given by the Malayan Agri-Horticultural Association or by the Agricultural Department. The Director of Agriculture thought that if a system of this description could be worked out for the whole of Malaya it would give the necessary impetus to padi competitions at shows which they at present lacked.

These proposals were submitted to the Agricultural Conference held in August, 1933, and were strongly supported by a Committee of the Conference appointed to consider the scheme. The scheme was also considered and accepted by the Committee of the Malayan Agri-Horticultural Association and by them was submitted to the Governments of the Straits Settlements, the Federated Malay States and each of the Unfederated States. These Governments were asked if they approved the general outlines of the scheme and would be prepared to put it into operation after the coming padi harvest. The replies received were on the whole favourable.

As a result of recommendations made during the consideration of the scheme Rules for a Malayan Padi Competition were drawn up, and are given below. Copies of these Rules have been forwarded to the Governments concerned and steps are being taken to hold the first Competition after the forthcoming padi harvest.

There are a few points in the Rules on which a short comment or explanation is desirable. Thus in Rule 4 it should be explained that the strains of padi approved by the Agricultural Field Officer for entry in each District Competition will not be confined entirely to those pedigree strains selected by this Department which are best suited to the district, but will also include any well known variety popular and widely grown in the district, as for example, Mayang Ebos, Radin Che Mah and Radin China in Kedah where selection work on these varieties is still in progress, Manik Siam, Anak Naga, Nalung and other varieties in Kelantan, and Padi Acheh in several districts in the Federated Malay States.

The Local Shows may be organised for the whole of an administrative district, or in districts containing a large area of padi land such as Krian, two or three Local Shows may be considered preferable in order to ensure the interest and attendance of the local padi cultivators.

While the Malayan Agri-Horticultural Association and this Department are prepared to provide bronze medals and certificates as prizes at Local Shows, the organisers are left free to present any other prizes which they may consider suitable.

Malayan Padi Competition.

Rules.

1. The Malayan Padi Competition shall be organised in two parts—

Part I — The Local Competitions.

Part II — The Central Competition at the Association's Annual Exhibition in Kuala Lumpur.

Part I. Local Competitions.

2. Each Local Competition shall be organised jointly by the District Officer and the Agricultural Field Officer of the Circle, State or Settlement in which the district is situated.

Entries.

3. Each intending competitor shall notify the District Officer or his representative, for example the Penghulu of his mukim, of his intention to enter for the competition not later than a date to be notified by the District Officer.

4. Before the commencement of the competition the Agricultural Field Officer for the Circle, State or Settlement shall furnish the District Officer with a list of strains of padi approved for entry in the competition. No padi will be accepted for entry unless it is of one of the approved strains.

5. Each exhibit entered for the competition shall be taken from an area of not less than ½ acre planted with the particular strain exhibited.

6. Each exhibit shall consist of 3 gantangs of padi and shall be delivered at the place appointed for the Local Padi Show on the date fixed by the District Officer for the receipt of exhibits.

7. Each exhibit must be accompanied by the entry form to be obtained either from the District Officer, the Agricultural Field Officer for the Circle, State or Settlement, the Penghulu of the mukim, the Malay Agricultural Assistant, or the Malay Agricultural Subordinate for the district or locality.

8. On the entry form shall be shown—

(i) The name of the Competitor.

(ii) The locality of the holding and if possible the lot number.

(iii) The size of the area from which the padi entered for competition was drawn.

(iv) The strain of padi entered.

(v) The yield of padi in gantangs harvested from the area under (iii).

9. Each entry form shall bear a certificate signed by the Penghulu of the Mukim or a Malay Agricultural Assistant or Subordinate to the effect that the statements made on the entry form in accordance with Rule 8 are correct; and

also a statement of the average yield of padi in gantangs per acre, relong or orlong for the mukim as officially determined.

Time and Place of Local Show.

10. The Local Show shall be held at such time and place as the District Officer may arrange.

Appointment of Judges.

11. Exhibits shall be judged by judges appointed by the District Officer.

Judging Exhibits.

12. In judging exhibits the data set out on each certified entry form shall be taken into consideration in addition to the merits of the actual sample to which it refers.

Prizes.

13. In each local competition prizes shall be awarded to the three best exhibits, but the judges shall at their discretion be entitled to award additional prizes and certificates.

Disposal of Exhibits.

14. At the conclusion of each Local or District Show the prize winning exhibits together with certified entry forms relating thereto will be retained by the Agricultural Field Officer of the Circle, State or Settlement for despatch to the Association's Annual Exhibition in Kuala Lumpur. Such exhibits so retained will be paid for by the Association at three cents per gantang above the standard market price for padi in the district or locality and will become the property of the Association. All other exhibits will be handed back to their owners or disposed of as the owners may direct at the conclusion of the Local Show.

Part II. Central Competition.

15. On a date to be fixed by the M.A.H.A. each Agricultural Field Officer shall despatch to Kuala Lumpur at the expense of the Association all winning exhibits collected from the District Competitions in his Circle, State or Settlement, together with the certified entry forms in respect thereof. He shall not state what prize was awarded to each exhibit in the Local Competitions and shall see that the entry forms do not convey this information.

16. These exhibits shall be displayed in the Section devoted to padi at the Association's Annual Exhibition in Kuala Lumpur. The assembled exhibits shall be judged in accordance with the standards of the Association, but there

shall also be taken into account the particulars furnished on the certified entry forms.

17. The Judges for the Padi Section shall be appointed by the Association.

18. Prizes shall be as follows:—

First Prize	—	A Diploma of Merit, the sum of $25, a Gold Medal, and a Challenge Trophy to be retained by the winner until the competition in the ensuing year.
Second Prize	—	A Diploma of Merit, the sum of $10, and a large Silver Medal.
Third Prize	—	A Diploma of Merit, the sum of $5, and a Silver Medal.
Fourth Prize	—	A Diploma of Merit, and a large Bronze Medal.
Fifth Prize	—	A Diploma of Merit, and a Bronze Medal.
Sixth Prize	—	A Diploma of Merit.

The judges shall be empowered to award additional prizes and certificates of merit at their discretion.

Selected Article.

THE WORLD RICE SITUATION.*

World rice production in the past decade has shown two very marked upward movements—in 1924-25 and 1930-31—with a less notable rise in 1928-29. In 1931-32, however, there was a pronounced fall in production. The data now available, which cover countries accounting in 1931-32 for about 93 per cent. of the world total excluding China, for which no reliable statistics exist, point to a continuance of the decline in 1932-33 though to a moderate degree, the percentage fall in the past season amounting to about 1 per cent.

World Production of Rough Rice†.

(*Million pounds*).

1931-32	...	...	...	194,735
1930-31	...	...	...	201,680
1929-30	...	...	...	188,760
1928-29	...	...	...	192,420
1927-28	...	...	...	184,241
1926-27	...	...	...	185,013
1925-26	...	...	...	185,299
1924-25	...	...	...	186,864
1923-24	...	...	...	172,733

† Not including that of China, Turkey and Persia.

In the past season there were considerable increases of production in Burma and in Siam, while that of French Indo-China appears to have remained practically at the same level, the decrease in Cochin-China being balanced by the increase in Annam; in Korea, Formosa, Japan and the Netherlands East Indies there were also increases. On the other hand there was a very great fall in production in India excluding Burma, the effect of this on the total being an indication of the critical part played by the area in determining the variation of world production as a whole. The variation of production in the principal producing countries, with the possible exception of French Indo-China, where the total has in the last few years remained relatively stable, and of Formosa, where there has been a continued increase, has been the reverse of that of the previous season.

Even without taking into account the very large but statistically unknown production of China, 94 per cent. of the world's total in the quin-quennium ending 1931-1932 was produced by the countries of monsoon Asia. Similarly, all but a relatively small proportion of the rice entering into international trade also originates in monsoon Asia, the principal surplus-producing countries being Burma (principally Lower Burma) French Indo-China (principally Cochin-China), Siam (almost entirely the five inner circles), Korea and Formosa. Since the two last-named countries supply principally Japan and form with that country practically an economic unit, the supply situation on the world market depends principally on the crops of Burma, French Indo-China and Siam.

* By C. J. Robertson, in *International Review of Agriculture*, Year XXIV, No. 6, June, 1933.

Unless otherwise stated all data have been converted to terms of milled rice and derivatives the latter including broken rice and white flour or meal but not bran.

The Situation in the Three Great Surplus Producing Countries.

Despite the countinance of low prices there was in the past season a recovery in the area under padi in Burma, though the maximum of 1930 - 31 was not regained. Production, which in the past decade has, with the exception of 1931 - 32, when a reduction in area coincided with a weak monsoon, fluctuated only slightly about the level of 12,000 million pounds, increased by 17 per cent. in the past season.

The increase in area in the past season took place particularly in Lower Burma, from which the bulk of the export is derived. Production in 1932 - 33 increased, thanks to the increase in area and to favourable weather, and the final estimate of the surplus available for export (that is the exports in the year beginning in the middle of last December) showed an increase of 28 per cent. on the very small figure of the previous season. As total exports in 1932 amounted to 6,326 million pounds while the final estimate of the export surplus from the 1931 - 32 crop was only 6,048 million pounds, there was presumably no carryover at the beginning of the present export season and domestic stocks were probably greatly reduced in 1932, so that the surplus estimated for the current year may be taken as a maximum; in any case, actual exports during the past ten years have been more often than not smaller than the surpluses as finally estimated.

Exports (mainly of milled rice) from Rangoon to foreign ports and to Indian ports, which together normally make up about three-quarters of the total export of Burma, in the period from 1st January 1933, a date only fifteen days after the beginning of the season, to 27th May, 1933 were respectively 1,535 million and 787 million pounds (against 1,970 million and 393 million in 1932), in all 2,322 million against 2,363 million pounds.

Production and Net Export of Major Exporting Countries.

(*Million pounds of rice and rice derivatives*).

Production					Net export			
Year	Burma	French Indo-China	Siam	Year	Burma* to foreign countries	to Indian ports	French Indo-China	Siam†
1932-33	12,142	8,364§	8,120‡	1933	—	—	—	—
1931-32	10,351	9,034	6,781	1932	4,218	2,107	2,624	3,379
1930-31	12,724	9,624	8,044	1931	4,323	3,177	2,101	2,683
1929-30	12,335	9,557	6,458	1930	5,187	2,015	2,465	2,315
1928-29	12,108	9,250	6,470	1929	3,930	2,269	3,229	2,625
1927-28	12,088	10,333	7,607	1928	3,379	2,856	3,904	3,500
1926-27	12,647	9,561	8,710	1927	4,383	2,414	3,630	3,708
1925-26	11,734	9,440	6,989	1926	4,621	1,457	3,506	2,780
1924-25	12,536	9,241	8,236	1925	4,805	2,754	3,277	2,947
1923-24	10,309	8,334	7,332	1924	4,138	1,042	2,646	2,278

* The official data are for rice both in the husk and not in the husk but, as practically all the rice exported is milled, they have been taken to represent milled rice and derivatives.

† Exports from Bangkok, which make up 98 per cent. of the value of the total rice exports from Siam. Data refer to the season from 1st December to 30th November.

§ Not including Cambodia.

‡ Provisional estimate.

Production in French Indo-China has fluctuated in the last decade between 9,000 and 10,000 million pounds. The export originates mainly in Cochin-China, which produces about one-third of the total. Rather less favourable conditions during the period of transplanting outweighed the increase in area in this region. The export surplus from the past crop is considered to be smaller than that from the 1931 - 32 crop; the most recent estimate places the surplus for export from Saigon during the present year at 2,464 million pounds, 291 million smaller than in 1932. Actual exports in the first three months of 1933 showed an increase of 13 per cent. on those in the corresponding period of 1932.

Production in French Indo-China.

(*Million pounds of rice and derivatives*).

Year		Cochin-China	Cambodia	Tonkin	Annam	Laos
1932-33	...	3,267	—	2,892	1,642	563
1931-32	...	3,636	781	2,903	1,183	531
1930-31	...	2,985	1,446	3,220	1,442	531
1929-30	...	3,484	1,047	2,990	1,505	531
1928-29	...	3,405	976	2,849	1,473	547
1927-28	...	3,876	1,273	3,013	1,543	628
1926-27	...	3,405	1,448	2,211	1,918	579
1925-26	...	3,240	1,179	2,923	1,535	563
1924-25	...	3,565	902	2,521	1,770	483
1923-24	...	3,314	927	1,801	1,646	644

In Siam, as in Burma and, to a much less extent, in French Indo-China, there was an increase in the area of rice harvested in the past season, amounting in this case to 8.5 per cent. Production increased more than proportionately, namely by 20 per cent. The final estimate of the exportable surplus is 3,942 million pounds, which is over double the small export surplus of the previous season. Actual exports from Bangkok in the first four months of the export season were larger than those in the corresponding period of the last season.

The Situation in the Minor Exporting Countries.

While their total production is relatively insignificant as compared with that of the great Asiatic producers, certain of the minor producing countries have special importance on the European and other markets where a demand for high-quality rice exists.

Amongst these producers of high-quality rices the most important are the United States, Italy and Spain.

There was a pronounced fall in production in the United States in 1932 - 33 and a slight fall in Italy, but in Spain production rose almost to the 1926

maximum. In the last-named country the increase in production, amounting to 19.5 per cent. with respect to 1931, was due in part to increase in area, which amounted to 8.6 per cent., but still more to favourable growing conditions. In the United States there was a general reduction in area and in three Southern States (Louisiana, Texas and Arkansas) unfavourable weather also played a part in reducing production to a figure 14.5 per cent. below that of 1931 and 9.0 per cent. below the average for 1926 - 30. In Italy a reduction in area under the crop was outweighed by conditions on the whole favourable to growth.

Amongst other minor producers of relative importance Egypt had in the past season a production much above the five year average, thanks to the abundance of irrigation water, which enabled the Government to authorize an area under the crop over seven times the greatly reduced area of the previous year.

Production and Net Export of Minor Producing Countries.

(*Million pounds rice and derivatives*).

Year	Production Italy	Spain	U.S.A.	Year	Net export Italy	Spain	U.S.A.*
1932 ...	1,057	491	1,240	1933 ...	—	—	—
1931 ...	1,066	411	1,449	1932 ...	335	87	270
1930 ...	1,084	482	1,415	1931 ...	327	83	237
1929 ...	1,016	452	1,279	1930 ...	456	125	252
1928 ...	1,120	448	1,368	1929 ...	379	86	376
1927 ...	1,094	478	1,410	1928 ...	413	131	286
1926 ...	1,013	494	1,338	1927 ...	561	118	251
1925 ...	951	472	1,047	1926 ...	430	142‡	60
1924 ...	838	456	1,015	1925 ...	333	99	68
1923 ...	747	374	1,062	1924 ...	387	116	165

* August July. ‡ Net import.

Exports from Italy, which in 1932 showed a decline of 3 per cent. for milled rice and of 11 per cent. for brown rice, declined further in the first quarter of 1933 with respect to the same period of last year by 56 per cent. and 35 per cent. respectively. Exports of rough rice on the other hand, increased about 8½ times in 1932 and over three times in the first quarter of 1933. In Argentina which is the most important foreign market for Italian rice, there is reported to have been a great increase in the area harvested. Exports of milled rice from Spain increased by 4 per cent. in 1932, the decrease in takings of the United Kingdom and Cuba, the two leading markets, have being outweighed by the increase in those of France and certain other countries. Exports of milled rice from the United States, which go principally to the United Kingdom

and Germany, declined by 27 per cent. in the first quarter of 1933 with respect to the corresponding period of 1932.

The relatively large export from Egypt in 1932 in comparison with previous years, which may be expected to be repeated this year, irrigation water in that country being again abundant, will accentuate competition in the Levant and the Balkan countries.

Exports from Brazil, the principal South American country with a surplus, which are directed chiefly to Argentina, Uruguay and Germany, were in 1932 less than one-third of the record figure of 1931; in the first three months of 1933 they were 88 per cent. below the figure for the corresponding period last year. British Guiana, which has a growing export surplus, is finding difficulty in its principal market, the British West Indies, owing to the competition of Burma rice.

Conditions in the Principal Rice-Importing Countries.

Production in India (excluding Burma), which is the world's greatest producer of rice with the possible exception of China, for which no reliable data are available, fluctuates very markedly depending on the character of the monsoon. In 1931 - 32 production attained the maximum of 71,262 million pounds rice and derivatives, area having been increased by 2.6 per cent. and rainfall having in that year been unusually favourable over the greater part of the area. In 1932 - 33, however, there was a reduction of 3.3 per cent. in area and rainfall was not so uniformly satisfactory. In Bihar and Orissa, which is normally second to Bengal amongst the provinces of India as a producer, the decline in production was no less than 26.8 per cent. below the level reached in the previous season. The deficit regions of India as a whole derive the bulk of their supplies from Burma. The relative shortage in India this year is reflected in the fact that coastwise imports from Burma up to 27th May amounted to 787 million pounds against 393 million up to the corresponding date in 1932.

As regards China, information is as usual somewhat vague; it is reported that the 1932 - 33 crop was above average and probably about the same high level as that of 1930. In this case it may be expected that imports in 1933 will fall from last year's high figure to the low level of 1931. In fact, imports in the first quarter of 1933 were 25 per cent. smaller than those in the corresponding period of 1932.

Amongst the importing countries of the second rank, the Netherlands East Indies have in the past five years taken the first place. Imports into Java and Madura fluctuate considerably from year to year, depending on the size of the domestic crop; production in 1932-33 was larger than that of the previous year and than the average of the five years ending 1930 - 31. For the Outer Provinces data of production are not available but it is known, that owing to the concentration of the natives on export crops and to the rapid increase of population comparatively few areas have normally a surplus. Imports into these Provinces are larger and more uniform than those into Java and Madura. In

Production in Certain Provinces in India.

(Million pounds rice and derivatives).

Year		All-India excluding Burma*	Bengal	Bihar and Orissa	Madras
1932-33	...	63,699	23,063	10,393	12,957
1931-32	...	71,262	23,483	14,198	13,322
1930-31	...	66,935	22,775	13,890	13,300
1929-30	...	64,686	20,292	14,872	13,001
1928-29	...	67,420	23,958	13,825	12,857
1927-28	...	57,764	16,064	10,832	12,576
1926-27	...	60,782	18,196	11,846	11,732
1925-26	...	64,311	20,331	12,095	13,167
1924-25	...	64,337	19,078	14,902	12,143
1923-24	...	59,453	18,587	12,118	11,210

* The all-India statistics exclude the production of the Punjab, the North-West Frontier Province, Ajmer-Marwara, Manpur, Pargana and certain other Indian States, which together produced 2,602 million pounds on the average of the five years ending 1930-31; they also exclude the production of the feudatory States of Bihar and Orissa, for which no reliable data are available.

the first quarter of this year imports into Java and Madura showed a decrease of 19 per cent. with respect of those in the same period of 1932; those into the Outer Provinces during the same period were practically the same as last year, there being an increase of 0.4 per cent. Imports into the Netherlands East Indies have been prohibited for the period from 21st March 1933 to 21st July 1933. This embargo will affect particularly Burma, the chief source of imports, but is also a serious blow to the export trade from Siam and Cochin-China. Rice may, however, be imported into the Sumatra East Coast and Celebes by licence, should these Provinces require such imports.

In British Malaya acute distress in the rubber and tin industries still dominates the situation in the Peninsula. This has not only greatly reduced the purchasing power in the country, both by a general lowering of the standard of living and by leading to the return to India of much immigrant labour, but has also lead to an increase in the area under rice; not only is there the stimulus to many who formerly earned a living from employment in the major exporting industries to engage in rice cultivation but serious efforts are being made by the Government to encourage rice-growing with a view to lessening dependence on export crops and assuring a domestic supply of foodstuffs. Yields in the past season were very satisfactory in several States and the crop was generally well above the average. Imports, which have shown a downward tendency in the past two years, were 11 per cent. smaller in the first quarter of this year than in the corresponding period of 1932. The decline in imports of Burma

rice, which is preferred by the immigrant Indian population, was proportionately greater. The falling off in this market affects principally, however, Siam rices, which take the first place in imports, largely owing to the taste of the Chinese population.

Net Imports into the Principal Asiatic Countries of Deficit other than India Proper and Japan.

(*Million pounds rice and derivatives*).

Year		China	Netherlands East Indies	British Malaya	Ceylon
1932	...	2,992	899*	921	1,024
1931	...	1,427	1,303	1,156	1,006
1930	...	2,647	1,357	1,392	1,064
1929	...	1,439	1,592	1,256	1,102
1928	...	1,683	1,257	1,177	1,093
1927	...	2,799	1,003	1,228	1,053
1926	...	2,489	1,292	1,068	1,033
1925	...	1,679	1,109	907	972
1924	...	1,759	906	880	884

* Not taking into account the relatively small export from the Outer Provinces.

In Ceylon, as in British Malaya, reduced employment on the plantations with consequent lower purchasing-power and stimulus to local rice production, has resulted in the last two or three years in a decline in rice imports. In the first four months of 1933 the decline in the total with respect to the corresponding period of last year was 14 per cent. This reduction has been felt less severely by Burma, the principal source of imports, than by Siam and Cochin-China, the quantities originating in the latter two countries being, however, small in comparison with those from India proper.

Japan rivals India proper in the quantity of its imports but, as it derives less than one-fifth of its total imports from foreign countries—the remainder being taken from its dependencies, Korea and Formosa—its importance on the world market is very small compared with that of India, China, British Malaya, Ceylon and the Netherlands East Indies.

Imports into Japan fluctuate within wide limits and generally inversely to domestic production. In recent years, as production in Korea and Formosa has increased, imports from foreign countries have been reduced. Production in the past season was 9.4 per cent. above that of last year and slightly below the five-year average. Korea, which is the principal source of rice imports, slightly increased its production despite a decrease in area, while in Formosa the first crop which is that exported to Japan, was a very large one, thanks partly to

Sources of Supply of Japan.

(*Million pounds rice and derivatives*).

Production				Net import of Japan			
			Formosa	From foreign	From	From
Year	Japan	Korea	(first crop)	Year	countries	Korea	Formosa
1932-33	19,020	5,079	1,322	1933	—	—	—
1931-32	17,346	4,999	1,143	1932	253	1,960	—
1930-31	21,063	6,041	1,094	1931	91*	2,385	723
1929-30	18,758	4,305	896	1930	287	1,318	497
1928-29	18,945	4,245	1,004	1929	384	1,439	521
1927-28	19,510	5,435	1,022	1928	474	1,816	567
1926-27	17,465	4,807	892	1927	1,278	1,440	642
1925-26	18,804	4,641	997	1926	748	1,459	578
1924-25	17,961	4,163	939	1925	1,671	984	567
1923-24	17,463	4,779	819	1924	1,073	1,132	—

* Net export.

increased area but mainly to favourable weather and to the energetic measures taken by the Government on behalf of rice-growing. Total production in Japan and its dependencies was almost exactly halfway between the very small figure of the previous season and the record high figure of 1930-31. Stocks are reported to be larger than last year. Government control over the rice trade has been strengthened. Taking all these considerations together it may be expected that imports from foreign countries will this year show a further decline. In fact, while gross exports were 2 per cent. larger in the first three months of the year than those in the corresponding period of 1932, net imports were 20 per cent. smaller. Thanks to treaty obligations Siam and the United States are the only foreign countries to retain any considerable share in the import into Japan; the imports from the former are by far the greater of the two and are mainly composed of brokens.

The Principal European Importing Countries.

European imports make up roughly one-fifth of the total international trade in rice. By far the greater part of this rice is worked up in the European mills and much of it is re-exported, generally after milling.

Germany, the largest European importer, takes milled rice and unmilled rice in relative proportions varying from year to year, both principally from Burma. In 1932 the imports of unmilled rice, in that year the larger of the two, showed a decline of 4 per cent., while those of milled rice declined by 9 per cent; exports of milled rice, which are very widely distributed, declined by 24 per cent., a still greater decline than that of the previous year. In the first four

months of 1933 there was a decrease of 6 per cent. in imports of unmilled rice and an increase of 11 per cent. in those of milled rice with respect to the corresponding period of last year.

The new import duties and monopoly surcharges that came into force last December together constitute a serious blow to the rice import trade. The reduction in the rate of drawback on the customs duty on husked rice imported into Poland for working up may also be mentioned in this connection.

France imports mainly milled rice. In 1932 its imports of whole milled rice, flour and semolina, chiefly from French Indo-China, increased by 33 per cent. and those of brokens by 13 per cent. while those of rough rice, mainly from Italy, decreased by 10 per cent. In the first quarter of 1933 the total imports increased by 24 per cent; a large increase in those from the colonies outweighing a decrease of 30 per cent. in imports from foreign countries.

The Netherlands import of rough rice, which is mainly from Burma and Japan, decreased in 1932 by 51 per cent., while that of milled rice decreased by 47 per cent. Exports, which are very widely distributed, decreased by 10 per cent. in the case of rough rice, which goes mainly to Germany, and by 22 per cent. in that of milled rice, which is sent chiefly to Germany and the United Kingdom. In the first four months of 1933 imports of rough rice increased by 72 per cent. while those of milled, including brokens, increased by 5 per cent.

Imports into the United Kingdom are almost entirely of milled rice, chiefly from Burma, Spain and the United States. That from Burma is generally re-milled, however; there is a large import of brokens from this source. In 1932 there was a further increase of 2 per cent. in the total imports, those from British India (mainly Buma), increased by 13 per cent. but those from Spain and the United States decreased by 9 per cent. and 12 per cent. respectively. In the first five months of 1933 there was a decrease of 12 per cent. in the total imports, of 64 per cent. in those from the United States and of 96 per cent. in those from Spain, while those from British India increased by 32 per cent. The great falling off in foreign imports in the current year is due to the coming into force on 1st January, 1933 of a duty of 1d. per lb. on foreign whole milled and cargo rice. Only the superior quality of certain foreign rices enables them to retain part of the market.

The General Outlook.

World production appears to have undergone a further decrease in 1932 - 33. The variation with respect to the previous year in the individual regions of production has, howeveer, been in general the reverse of that in 1931 - 32. Production in 1932 - 33 in the three major exporting countries, Burma, French Indo-China and Siam, taken together increased, due mainly to the fact that weather during the season was on the whole more favourable in these countries than in 1931 - 32, when climatic conditions were bad.

In Japan and its dependencies production also increased, mainly as a consequence in Japan and Korea, too, of a reversal of climatic conditions with respect to those of 1931 - 32; in China also the bad climatic conditions of 1931 - 32 appear to have been succeeded in the past season by unusually favourable conditions. In India proper, on the other hand, the rainfall conditions were unsatisfactory in several important areas so that the heavy crop of 1931 - 32 was followed by a deficitary crop in 1932 - 33. In Java and probably in other importing countries of the second rank there were larger crops due in great part to increase in area under the influence of the depression in export crops and the efforts of the Governments concerned to stimulate domestic food production.

Amongst the major exporting countries only Burma, therefore, with its strong position in the Indian market, finds itself this year in a more favourable situation. Its new preferential advantage in the United Kingdom is largely offset by a deterioration of the position in continental markets. In China and the Far Eastern market generally the position has, from the point of view of the exporting countries seriously deteriorated; given the above-mentioned position of Burma, however, this will react most severely on French Indo-China and Siam, which normally, and especially in the latter case, market the great bulk of their surplus in the Far East.

As regards the trade in high-quality rices the general conditions of depression in purchasing-power and of increased taxes on the product in European markets lead to the expectation of still more acute competition amongst exporters of these qualities.

Review.

The Empire Journal of Experimental Agriculture, Vol. I No. 2 July, 1932, pp. 98-192.

The second number of the latest addition to agricultural publications has recently come to hand, namely, Vol. I No. 2 of the Empire Journal of Experimental Agriculture, the first number of which made its appearance in April.

Much discussion has arisen with regard to the necessity for such a publication in view of the large number of journals of a similar character already in existence.

The necessity for and success of such a new organ of agricultural science must be judged by the ability of the publication committee to fill, and keep filled, the pages with matter of sound scientific agricultural interest and of high technical standard.

From this second number it would appear that such conditions are being fulfilled. This number deals with items as diverse as inheritance of wool characters in sheep and the statistical analysis of incomplete field results.

The first article by Dr. B. A. Keen is descriptive of experimental work carried out at Rothamsted on comparative tests of rotary cultivation and ridge ploughing and, although such comparative tests are not largely applicable in Malaya, they are of interest as suggesting contrasts between deep changkolling and ploughing.

The second paper is a short symposium by Dr. F. Hardy on tropical red soils in which properties of such soils from India, West Indies, South America and South Africa are compared.

The third paper by K. T. Hartly and M. Greenwood is on the effect of applications of small amounts of farmyard manure to cereal (guinea corn) crops in Nigeria. Their results on the whole appear somewhat inconclusive as shewn in the summary. It was found, as has been found locally, that farmyard manure increased the crop to a larger extent than an equivalent of artificials though, in this case, the results do not appear comparable, no "completes" being tried. The results of nitrogen trials appear inconclusive.

The paper by Martin G. Jones and J. O. Thomas on the effect of stock grazing on grassland ecology, although consisting of observations in a temperate climate, is of interest to any country which offers possibilities of sheep or cattle raising. Their main conclusions are that while nitrogenous manures nearly doubled the actual fodder yield it was without influence on the botanical composition. On the other hand, time and intensity of grazing markedly affected the botanical composition both in proportion of grass to clovers (in this experiment) and in the inroad of weeds.

The fifth paper by F. Yates on the statistical analysis of replicated experiments, when field results are incomplete, appears to have arisen owing to the work of Allan and Wishart who established formulae for the estimation of a

single missing plot. As the author points out the method of the latter becomes involved when applied to more than one missing plot. The method of Yates is that of minimising the error variance obtained when unknowns are substituted for the missing yields. In practice this consists in the application of a first and second approximation to the missing plots.

A paper on silage by Arthuri I. Vestanan is chiefly of interest to dairy farmers, being descriptive of methods of preserving fodder as close to fresh conditions as possible.

A. Reifensberg and E. K. Ewborik continue their paper on soil profiles of Cyprus in this number. The first paper was descriptive of soils from limestone and serpentine. This second paper deals with weathering of other igneous rocks, diabase gabbro-norite and pillow lava.

The last two papers are devoted to sheep. One of these by J. A. S. Watson, D. Shilbeck and J. C. B. Ellis is on the food consumption of fattening sheep. The other is a general review of inheritance of wool characters in sheep by William C. Miller of the Institute of Animal Genetics, Edinburgh.

As a criticism a point which might be stressed is the immense utility of a summary and conclusions for all papers descriptive of original work. Such summaries enable the general reader immediately to ascertain whether the article in question is of interest or intelligible, while the specialist can quickly estimate the value of a given article to his own particular work.

J. H. D.

Departmental.

FROM THE DISTRICTS.

The Weather.

The usual cool wet weather characteristic of November was experienced generally throughout the Peninsula. Rainfall was up to the average in the North and South, being above the average in parts of Kedah. In the central belt of the Peninsula, however, stretching from the south of Perak to the north of Johore and from the west coast across to Temerloh and Pekan districts of Pahang the precipitation was in varying degrees below the average for the month.

Remarks on Crops.

Rubber.—The average price of rubber showed a slight rise probably caused by the improved prospect of introducing restriction. The highest and lowest prices in dollars and cents per picul recorded during the month for rubber from small holdings were :—Smoked Sheet $9—$18; Unsmoked Sheet $7.50—$17; Scrap $1.80—$7.10; Slab $3.50—$8.50. The average Singapore prices recorded for small-holders' rubber were :—Smoked Sheet $16.50; Unsmoked Sheet $15; Scrap $5 as compared with $15.50, $14.50 and $5 in October. The Penang prices for Unsmoked Sheet ranged from $12—$14.20 as compared with $12.60—$14.40 in October.

The number of small holdings tapped in all parts of the Peninsula showed a further increase during the month. Tapping systems were often severe with resultant damage to the bark. Mention was again made of the use of ladders in tapping, more especially in the Negri Sembilan. Rain interfered with morning tapping everywhere and reduced yields. In Kelantan it practically put a stop to all tapping. In some areas the effect of morning rain was avoided by afternoon tapping; in Johore tapping before daybreak was resorted to in some localities.

During the prevailing wet weather Mouldy Rot disease was much in evidence. In some districts its control is receiving more attention from small-holders and the use of approved disinfectants is extending, more especially in Kedah, Selangor, Western Pahang and parts of the Negri Sembilan.

From Kelantan it is reported that although hand rollers have been offered to Societies and individuals on very easy terms, local belief in the advantage of selling a large weight of rubber, however wet and dirty, rather than good sheet has proved difficult to overcome. One small-holder has, however, taken delivery of rollers and has produced greatly improved rubber and now wants to purchase latex from his neighbours. This man is receiving further instruction in the preparation of good rubber.

The number of Malay owned smoke houses in the Kuala Langat district of Selangor is increasing and the quality of rubber produced is improving. One

Malay, who already deals in copra, has undertaken to buy this rubber and sell it direct to the exporting agents.

Padi.—The price of padi at the Government Rice Mill, Bagan Serai, was $1.62 per picul, a fall of 8 cents per picul as compared with the price in October. There was a similar slight decrease in the price in Kedah towards the end of the month, but in Province Wellesley the price improved to $7 per 100 gantangs. Elsewhere there were slight rises of price in some areas, the range being 5 to 13 cents per gantang.

Planting was practically completed throughout the Peninsula by the end of the month, the wet weather having favoured transplanting in areas such as Kuala Selangor district where work had been delayed by drought. Crop prospects continued to be good in Kedah, Province Wellesley, Krian, Malacca and parts of Pahang.

Harvesting has commenced in the Jelebu district of Negri Sembilan and in some of the riverine areas in Pahang. In the latter States it is now expected that the crop will be reaped before serious damage by floods is likely to occur. In some districts of Johore harvesting has been completed, in others it is in progress, while in some planting has only just been completed. Rats, birds and stem-borers have caused extensive losses of grain and reduced what should have been a good crop to moderate proportions. The conditions under which padi is grown in many parts of Johore render the control of these pests extremely difficult.

In Selangor the short term padis have given very satisfactory yields ranging from 200—450 gantangs per acre. The indications are that, if the planting of two crops a year were given a fair trial by the growers, it would prove a success in these areas.

Coconuts and Copra.—The price of copra again declined slightly, averaging $2.50 per picul in Singapore. The price range in Penang was $2.13—$3.20, and elsewhere it was $1.70 to $3.20.

Although the price of copra is discouraging, progress in the erection of approved kilns is recorded from Province Wellesley, Krian and Kelantan. In Selangor copra production by Malays has continued steadily, though in Kuala Selangor district padi planting has caused the suspension of manufacture on some kilns, and in Temerloh district padi harvest has temporarily reduced the number of nuts collected, although a new kiln has been completed at Kertau.

On the west coast of Johore the sale price of fresh nuts exceeds their value as copra. In that State, as also in Selangor and Malacca, the production of home-made coconut oil is increasing.

A course in the preparation and marketing of improved copra was held in Selangor from November 21st to December 2nd for 8 Malay Agricultural Officers and 6 Penghulus from Johore and 2 Malay Agricultural Assistants from Malacca. All officers showed a keen interest in this work and appeared

to have acquired a sound knowledge of the subject when examined orally at the end of the course.

Fruit.—In Perak, Selangor and Singapore Island the second crop of durians and mangosteens began to appear on the markets, while in Central Perak langsats and rambutans were approaching maturity. The crop in Singapore was small and the local fruit crop in eastern Pahang was reported to be poor.

Pineapples.—Harvesting of the second main crop proceeded during the month. One factory was operating in Selangor, five in Johore and three in Singapore. Prices for fruit paid by the factories showed a considerable improvement, more especially in Johore and Singapore. First quality fruit in Johore fetched $2 to $2.50 per 100 and second quality $1.50 to $1.80, while the corresponding prices in Singapore were $2.50 and $1.25 per 100 fruits.

On two large areas in Johore where pineapples are grown as a sole crop, good growth has been observed.

Tobacco.—Interest in the cultivation of this crop has on the whole been well maintained. Prices for first quality dried leaf have varied considerably in different areas, ranging for the most part from $17 to $45 per picul. In Johore, however, prices for leaf of good quality were as high as $60 per picul.

In Singapore Island several growers are attempting to produce Virginian cigarette tobacco from seeds supplied by this Department. Prices for cigar leaf ranged from $35 to $70 per picul and bright cigarette leaf of good quality will realise $80 per picul.

Agricultural Stations.

At all Stations good progress during favourable weather conditions was made with planting and supplying programmes and the pruning of one year old tea bushes. The budded citrus trees imported about a year ago from South Africa have grown well, especially at Bukit Mertajam, Kuala Kangsar, Cheras and the Pineapple Experiment Station in Singapore.

At the Agricultural Experiment Station, Tanah Rata, the crop of Arabian coffee was harvested and samples are being prepared for despatch to London with a view to obtaining a report on quality and a valuation. Fifteen species of fodder grasses from England were received and were being planted, so that there is now quite a large collection of such grasses under trial. A collection of different varieties of several kinds of vegetables from England, Australia and India is also being made.

Two pure-bred Light Sussex cockerels and four pure-bred pullets were received at the Sungei Udang Station in Malacca from England.

A party of Penghulus and Ketuas from surrounding mukims, accompanied by the District Officer and Deputy Assistant District Officer, Krian, numbering 118 persons in all, visited the Titi Serong Padi Station on the 9th November.

The Principal Agricultural Officer, Johore, and also the Malay Agricultural

Assistant, Segamat, with a party of Penghulus from his district visited the Pulau Gadong Padi Station in Malacca.

Padi Test Plots.

Planting was practically completed at the Padi Test Station, Panchang Bedina, and the Haji Durani Test Plot in Kuala Selangor district. Planting on the Sungei Blat Test Plot in Kuantan district of Pahang was well advanced.

A second bed of padi straw for the cultivation of the mushroom *Volvaria volvaccae* was established at the Bukit Merah Padi Test Station and yielded well early in the month. On November 29th a demonstration of mushroom growing was given to a party of Penghulus at this Station. A similar bed has been made at the Kuang Padi Test Station in Selangor. Spawn for trial has been sent from Province Wellesley to the Agricultural Officers in Pahang and North Johore.

Weekly Fairs.

In a recent report by the Chairman of the Weekly Fairs Committee in Kedah it is estimated that 18,000 buyers and sellers attend the 39 fairs each week and that the average value of the sales made per fair is $250 per week.

The Assistant Principal Agricultural Officer, Kedah, gave a demonstration at one fair of the construction of frame bee-hives and the care of the local bee (*Apis indica*).

School Gardens.

The annual inspection of gardens in Larut and Matang District for the award of the District Shield was carried out during the month. The shield was won by Matang School with Changkat Jering School a close second. Judging of gardens in Perak South and Pahang was commenced. In the latter State some very good gardens were seen, showing a marked improvement during the last few years. In Johore judging for the annual competition took place between November 16 and 20th; with but few exceptions the standard attained was very satisfactory, particularly as all the gardens have only been established for a comparatively short period.

Home Gardens Competitions.

Judging in the home garden competition in Tapah mukim was completed, there being 20 gardens to inspect. In the Negri Sembilan judging in this competition was commenced. It is reported that some of the gardens were very creditable and that much real enthusiasm existed among the majority of exhibitors. In the Pahang competition results generally were poor, but some very creditable gardens were seen in Mukim Chenor of Temerloh district and Mukim Semantan Ulu of Raub district. In Selangor all competitions for the year have been completed. They have done much to foster interest in this work and a large number of those who opened gardens solely for the purpose of the

competition have continued to cultivate them, since they have discovered what an asset a vegetable garden can be in assisting the family budget.

Carp Rearing.

Many Chinese vegetable gardeners and land owners rear four species of carp in old mining pools or artificially made fish ponds, but up to the present few Malays have shown any interest in this minor industry. Some twelve months ago, however, a Malay at Budu in Pahang obtained carp fry from the Fisheries Department in Singapore and stocked a pond on his land. In November he made the first sale of fish at the local weekly fair. The fish were about one year old, weighed between 3½ and 4 katis each and realised 25 cents per kati. This was quite a good price, since in Selangor the fish reared by Chinese are retailed for 13 to 24 cents per kati according to the variety. It appears, therefore, that carp rearing in parts of Pahang where the supply of fish is strictly limited would be a profitable undertaking for any Malay who has, or can easily construct, a suitable pond.

DEPARTMENTAL NOTES.

Visits and Tours.

The Director of Agriculture, Dr. H. A. Tempany, C.B.E., paid an official visit to the State of Negri Sembilan from November 7th to November 9th. During his visit he inspected the Agricultural Stations and Padi Test Plots in the State and discussed matters relating to agricultural policy with the Hon'ble the British Resident and the Agricultural Field Officer.

On November 21st the Director visited Singapore and attended a Conference, with representatives of the Singapore Chamber of Commerce, regarding projected legislation in connection with the pineapple industry. On November 22nd he gave evidence before the Straits Settlements Trade Commission and, in addition, visited and inspected the Pineapple Station at Lim Chu Kang and discussed agricultural problems with the Hon'ble the Colonial Secretary and the Agricultural Field Officer.

Agricultural Advisory Committee.

A meeting of the Agricultural Advisory Committee was held at the Head Office of the Department of Agriculture on November 16th—17th. On the first day the Committee paid an official visit to the Experimental Plantation, Serdang, and inspected the various lines of experimental work in progress.

At the meeting held on the 17th November, the following matters were discussed:—distribution of disinfectants to small-holders for control of mouldy-rot disease of rubber trees; home gardens competitions; poultry; the Malayan padi competition; importation of palm oil into U.S.A.; Copra; projected legislation re the pineapple canning industry in Malaya; farm schools at Agricultural Stations in Malacca and Singapore; shipment of bananas from Malaya to other countries; development of the rice industry in Malaya.

The meeting was informed of the resignation of Mr. C. B. Towill from the Committee and recorded its regret thereat. It was mentioned that it is proposed to nominate Mr. G. Teale of Messrs. Cumberbatch & Co., Ltd., as Mr. Towill's successor.

School of Agriculture, Malaya.

Enquiries have been received from various sources as to the possibility of recruiting students from the school for employment locally, the prospects offered being, in the majority of cases, very attractive. This interest is definitely encouraging, particularly as there is evidence that it will expand.

A special course of instruction in bud-grafting of rubber was held during October and November 1933. Instruction was given by one of the Malay conductors of the Rubber Research Institute, by arrangement with the Director of the Institute.

An outbreak of eye-worms in the poultry at the School, as well as intestinal round-worms and some other troubles, gave opportunities for practical instruction in poultry diseases.

Changes in Accommodation at the Head Office, Kuala Lumpur.

The laboratory of the Government Entomologist has been moved to the bungalow, No. 607 Swettenham Road, about a quarter of a mile from the Department. The clerical staff now occupies the former Entomological laboratory. The office of the Director will in future be situated in the room immediately above the Chemical laboratory, and the Chief Field Officer will occupy the adjoining room. The room formerly occupied by the Chief Field Officer has been allotted to the Soils Division.

The Chief Research Officer and the Personal Assistant to the Director share the Director's former office.

MALAYAN AGRICULTURAL EXPORTS, OCTOBER, 1933.

PRODUCT.	NET EXPORT IN TONS.				
	Year 1932	Jan.-Oct. 1932	Jan.-Oct. 1933	Oct. 1932	Oct. 1933
Arecanuts ...	20,280	16,121	17,733	680	2,803
Coconuts, fresh† ...	108,123	100,607	86,401	10,637	7,947
Coconut oil ...	11,932	9,212	14,713	1,080	1,665
Copra ...	97,464	78,147	86,765	12,196	13,728
Gambier, all kinds ...	2,925	2,546	2,027	142	225
Palm kernels ...	1,248	973	1,713	130	280
Palm oil ...	7,892	6,290	9,247	892	2,129
Pineapples, canned ...	66,291	56,703	51,271	2,239	1,553
Rubber § ...	417,137	342,132	372,787‡	36,621	41,409
Sago,— flour ...	10,267	7,478	3,787	916	1,182
„ — pearl ...	3,128	2,716	1,917	580	273
„ — raw ...	4,148*	3,330*	3,482*	302*	412*
Tapioca,— flake ...	9,028	7,846	8,691	653	741
„ — flour ...	392	112*	182*	79	13
„ — pearl ...	19,977	16,564	14,568	1,193	1,636
Tuba root ...	165½	105½	399½	7½	56

† hundred in number. § production. * net imports.

‡ subject to amendment monthly.

Statistical.

MARKET PRICES

November 1933.

Rubber.—The price of rubber has remained fairly steady during the month, opening at 12¾ cents per lb. for Spot loose in Singapore and closing at 13½ cents per lb. The average price for the month was 13⅛ cents per lb. in Singapore, 4 3/32 pence in London and 8½ cents Gold in New York as compared with 12 15/16 cents, 3 31/32 pence and 7 9/16 cents Gold respectively in October.

Palm Oil.—The course of the market Liverpool/Continent during November on a basis of 5 per cent. f.f.a., c.i.f. was as follows:—November 2nd £16.0.0 per ton net, November 9th £15.10.0 per ton net, November 16th £15.0.0 per ton net and November 23rd £15.5.0 per ton net.

Prices in the U.S.A. landed weight per pound in bulk c.i.f. New York/Philadelphia were 2.70 cents Gold on the 2nd November, 2.70 cents Gold on the 9th November; 2.75 cents Gold on the 16th November; and 3 cents Gold on the 23rd November.

The price of palm kernels Fair Average Malayan Quality c.i.f. landed weight on the Continent was Shillings 7/9 per cwt. on November 2nd; Shillings 7/7½ per cwt. on the 9th November; Shillings 7/7½ per cwt. on November 16th; and Shillings 7/6 per cwt. on the 23rd November.

Copra.—Prices secured during November were similar to October prices, the highest Singapore price for Sundried during November was $3.40 per picul, and the lowest price $3.10 per picul. The average price per picul being $3.21 as compared with $3.20 during October.

The mixed quality averaged $2.52 per picul as compared with $2.60 per picul in October.

Coffee.—The price at Singapore for Sourabaya coffee continued steady, prices ranged according to grade, from $16 to $18 being similar to prices obtained during October. Palembang coffee averaged $12.31 during the month being quoted at $12 on the 3rd and $12.25 on the 24th; the average figure for October was $12.56.

Arecanuts.—Palembangs averaged $1.98 and Bila Whole $2 per picul as compared with $1.85 and $2 respectively during October. The range of Singapore prices for other grades was:—Split $2.50 to $4; Red Whole $3 to $4.50; Sliced $5 to $7.50 and Kelantan $3 to $3.50.

Gambier.—There was a further fall in the price of Block Gambier during November, the average price being $4 per picul, Cube No. 1 averaged $7.25. Corresponding figures for October were $4.33 and $7.50 respectively.

Pineapples.—Values decreased again during November, the average Singapore price per case being as follows:—Cubes $3.02, Sliced Flat $2.94 and Sliced Tall $3.07 as compared with $3.15, $3.08 and $3.20 respectively during October.

Tapioca.—The price of Flake Fair averaged $4.06 as compared with $4.41 in October. Pearl Seed averaged $5.17 a slight decrease on the October price of $5.26, and Pearl Medium averaged $5.50, the average price being $5.46 in the previous month.

Sago.—Pearl—Small Fair again declined in price, averaging $3.65 during the month; the price was $3.81 in October. Flour-Sarawak Fair averaged $1.80½ as compared with $1.72½ in October.

Mace.—Prices ruling during the month were nominal and similar to October prices, namely $70 per picul for Siouw and $50 per picul for Amboina.

Nutmegs.—Prices remained steady in November, Singapore price per picul for 110's was $19 and 80's averaged $25. Similar prices ruled during October.

Pepper.—Average Singapore prices during November were as follows:—Singapore Black, $13 per picul; Singapore White $22.25 and Muntok White $22.87; the corresponding figures for October were $12.83, $22.41 and $22.87 respectively.

Cloves.—As in the previous months, the demand for cloves remained small, nominal prices being $40 for Zanzibar and $45 per picul for Amboina.

The above prices are based on London and Singapore daily quotations for rubber; on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports are kindly supplied by Messrs. Guthrie & Co., Ltd., Kuala Lumpur, and the Singapore prices for coffee and arecanuts by the Lianqui Trading Company of Singapore.

1 picul = 133⅓ lbs. The Dollar is fixed at two shillings and four pence.

Note.—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57, Charing Cross, London, S.W.1.

GENERAL RICE SUMMARY.*

October 1933.

Malaya.—Gross foreign imports of rice (including stocks available for re-export) during October, 1933 amounted to 42,110 tons, as compared with 46,332 tons in October, 1932 of which 52 per cent. were consigned to Singapore, 17 per cent. to Penang, 7 per cent. to Malacca, 16 per cent. to the Federated Malay States and 8 per cent. to the Unfederated Malay States.

Of these imports, 67 per cent. were from Siam, 31 per cent. from Burma, 1 per cent. from Indo-China and 1 per cent. from other countries.

Total foreign exports of rice from Malaya in October, 1933, were 13,675 tons (including 242 tons local production) as compared with 17,486 tons in October 1932.

Of these exports 75 per cent. were consigned to Netherlands India and 25 per cent. to other countries.

Net imports for the period January to October 1933, were 357,981 tons as compared with 335,184 tons during the same period for 1932, an increase of 6.8 per cent.

India and Burma.—Total foreign exports of rice during September 1933, were 99,000 tons as compared with 159,000 tons in the previous month and 144,000 tons in September 1932, a decrease of 38 per cent. in respect of the previous month and a decrease of 32 per cent. in respect of the same period in the previous year.

Total exports during the period January to September 1933, were 1,564,000 tons as compared with 1,794,000 tons for the corresponding period of 1932, a decrease of 13 per cent.

Total exports of rice and bran from Burma during the period 1st January to 30th September amounted to 2,759,983 as compared with 2,597,096 tons in the corresponding period of 1932, an increase of 6.3 per cent.

Japan.—Restriction of Imports of Rice. Article 3 of an Imperial Ordinance which was promulgated at Tokio in the Official Gazette on October 13th, 1933, reads as follows:—"Rice may not be imported or exported without the permission of the Government except in cases provided for by Imperial Ordinance."

The Ordinance which was to take effect from 1st November, 1933, has been passed with a view to control the supply and price of rice which continues to cause the Government of Japan much anxiety. The countries, whose trade will be chiefly affected by the new restrictions on the import of rice, will be Siam, which provided 76 per cent. of the total foreign imports in 1932, and United States of America.

Formosa.—Area under padi (second crop in acres) in 1933 is 960,760, the area in the corresponding period of 1932 was 941,108, an increase of 2 per cent.

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*Abridged from the Rice Summary for October 1933, compiled by the Department of Statistics, S.S. and F.M.S.

The estimated production for 1933 is 645,263 tons being a decrease of 3 per cent. as compared to that of last year.

Siam.—Exports (approximate) during October 1933, amounted to 127,506 tons as compared with 129,769 tons in October 1932, a decrease of 2 per cent.

Netherlands India, Java and Madura.—For the period end of September 1933, the area harvested amounted to 8,529,000 arces an increase of 94,000 acres or 1 per cent. as compared with the corresponding period of 1932: the area damaged was 429,000 acres an increase of 85,000 acres or 25 per cent. as compared with 1932, and additional plantings awaiting harvesting amounted to 1,092,000 acres an increase of 72,000 acres or 7 per cent. The total acreage at the end of September 1933 amounted to 10,050,000 acres, an increase of 251,000 acres or 2 per cent. as compared with the same period in 1932.

Imports of rice into Java and Madura during January to August 1933 totalled 104,200 tons, a decrease of 5,910 tons or 3 per cent. as compared with the same period of 1932.

Imports of rice into the Outer Provinces during January to August 1933 amounted to 172,244 tons, an increase of 4,763 tons or 3 per cent. as compared with the same period of 1932.

French Indo-China.—Entries of padi at the port of Cholon from January to October 1933 amounted to 981,000 metric tons, an increase of 12,000 tons or 1 per cent. as compared with the same period of 1932.

Exports of rice from Saigon for the period January to October 1933 totalled 1,091,000 tons, an increase of 102,000 tons or 10 per cent. as compared with the corresponding period of 1932.

Ceylon.—Imports for the period January to September 1933, totalled 324,331 tons, a decrease of 12,692 tons on the imports for the same period of 1932.

Of these imports 19 per cent. were from British India, 10 per cent. from other countries.

Europe and America.—Quantities of rice shipped from the East were:—

(*a*) To Europe for the period January 1st to October 19th, 1,113,183 tons, an increase of 249,846 tons or 29 per cent. as compared with the same period of 1932. Of these shipments 49 per cent. were from Burma, 2 per cent. from Japan, 41 per cent. from Saigon, 7 per cent. from Siam and 1 per cent. from Bengal, as compared with 55 per cent. from Burma, 3 per cent. from Japan, 35 per cent. from Saigon, 4 per cent. from Siam and 3 per cent. from Bengal in 1932.

(*b*) To the Levant, period January 1st to September 30th, 1933, 28,904 tons, a fall of 16,419 tons or 36 per cent. as compared with the same period of 1932.

(*c*) To America and the West Indies for the period January 1st to September 21st, 1933, an increase of 32,259 tons or 32 per cent. as compared with the same period of 1932.

MALAYA RUBBER STATISTICS

ACREAGES OF TAPPABLE RUBBER NOT TAPPED ON ESTATES OF 100 ACRES AND OVER, FOR THE MONTH ENDING OCTOBER, 1933.

STATE OR TERRITORY	Acreage of Tappable Rubber end 1932	ESTATES WHICH HAVE ENTIRELY CEASED TAPPING		ESTATES WHICH HAVE PARTLY CEASED TAPPING		Total (3) + (5)	Percentage of (7) to (2)
		Acreage	Percentage of (3) to (2)	Acreage	Percentage of (5) to (2)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
STRAITS SETTLEMENTS :—							
Province Wellesley	44,734	1,447	3.2	8,376	18.7	9,823	21.9
Dindings	6,969	209	3.0	900	12.9	1,109	15.9
Malacca	111,780	4,995	4.5	17,662	15.8	22,657	20.3
Penang Island	1,635	626	38.3	260	15.9	886	54.2
Singapore Island	28,269	9,730	34.4	5,264	18.6	14,994	53.0
Total S.S. ...	193,387	17,007	8.8	32,462	16.8	49,469	25.6
FEDERATED MALAY STATES :—							
Perak	250,951	7,543	3.0	35,657	14.2	43,200	17.2
Selangor	308,379	8,335	2.7	41,181	13.3	49,516	16.0
Negri Sembilan	228,541	7,342	3.2	21,544	9.4	28,886	12.6
Pahang	38,141	6,142	16.1	5,619	14.7	11,761	30.8
Total F.M.S. ...	826,012	29,362	3.5	104,001	12.6	133,363	16.1
UNFEDERATED MALAY STATES :—							
Johore	325,747	24,365	7.5	33,626	10.3	57,991	17.8
Kedah (*a*)	114,551	5,254	4.6	8,984	7.8	14,238	12.4
Kelantan	21,175	7,840	37.0	2,303	10.9	10,143	47.9
Trengganu (*b*)	4,352	Nil	Nil	2,072	47.6	2,072	47.6
Perlis (*a*)	957	177	18.5	468	48.9	645	67.4
Total U.M.S. ...	466,782	37,636	8.1	47,453	10.1	85,089	18.2
TOTAL MALAYA ...	1,486,181	84,005	5.6	183,916	12.4	267,921	18.0

Notes :— (*a*) Registered companies only and are rendered quarterly.

(*b*) Registered companies only.

The above table together with a Summary, was prepared and published by the Statistics Department, S.S. and F.M.S. in November, 1933.

MALAYA RUBBER STATISTICS — TABLE I

STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX, FOR THE MONTH OF OCTOBER 1933 IN DRY TONS.

Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres estimated 2		Imports				Exports including re-exports				Stocks at end of month		
								during the month		January to Oct. 1933		during the month		January to Oct. 1933				
	Ports	Dealers	Estates of 100 acres and over	during the month	January to Oct. 1933	during the month	January to Oct. 1933	Foreign	From Malay States Labuan	Foreign	From Malay States Labuan	Foreign	Local	Foreign	Local	Ports	Dealers	Estates of 100 acres and over
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
MALAY STATES :—																		
Federated Malay States ...	...	13,084	11,520	12,041	112,263	10,096	89,726	Nil	Nil	Nil	Nil	18,563	2,531	145,283	58,887	...	13,616	12,017
Johore ...	...	3,158	2,742	3,956	35,987	4,300	43,373	Nil	4	Nil	119	1,758	6,346	13,940	65,485	...	3,000	3,056
Kedah ...	...	437	2,134	2,685	23,655	1,503	13,560	Nil	Nil	Nil	Nil	1,422	2,779	12,481	25,444	...	437	2,121
Perlis ...	...	11	12	13	84	27	135	Nil	Nil	Nil	Nil	Nil	37	Nil	238	...	16	10
Kelantan ...	...	323	225	223	1,829	859	5,371	175	Nil	923	Nil	105	1,067	807	6,964	...	426	207
Trengganu ...	...	55	50	182	1,368	91	683	Nil	Nil	Nil	Nil	Nil	273	Nil	2,051	...	55	50
Total Malay States	...	17,068	16,683	19,100	175,186	16,876	152,848	175	4	923	119	21,848	13,033	172,511	159,069	...	17,550	17,461
STRAITS SETTLEMENTS :-																		
Malacca ...	...	3,455	1,255	1,481	13,287			3		14		5,505		41,126		...	3,197	1,289
Province Wellesley	...	1,151	761	568	5,186			Nil		Nil						...	1,049	689
Dindings ...	...	47	170	104	992	3,110	23,742	Nil	13,122	Nil	159,649	7,484	Nil	64,847	Nil	...	43	177
Penang ...	1,571	5,511	12	8	49			1,583		7,881						1,750	5,527	11
Singapore ...	9,536	30,185	134	162	1,497			11,621		90,278		26,165		182,750		4,741	30,440	125
Total Straits Settlements	11,107	40,349	2,332	2,323	21,011	3,110	23,742	13,207	13,122	89,173	159,649	39,154	Nil	288,723	Nil	6,491	40,256	2,291
TOTAL MALAYA	11,107	57,417	19,015	21,423	196,197	19,986	176,590	13,382	13,126	99,096	159,768	61,002	13,033	461,234	159,069	6,491	57,806	19,752

TABLE II
DEALERS' STOCKS, IN DRY TONS 3

Class of Rubber	Federated Malay States	S'pore	Penang	Province We'sly D'dings M'cca.	Johore	Kedah
20	21	22	23	24	25	26
DRY RUBBER	10,104	25,822	4,805	4,110	1,393	156
WET RUBBER	3,512	4,618	722	179	1,607	281
TOTAL ...	13,616	30,440	5,527	4,289	3,000	437

TABLE III
FOREIGN EXPORTS

PORTS	For month	January to Oct. inc. 1933
Singapore ...	40,356	284,683
Penang ...	12,275	104,568
Port Swettenham.	7,235	61,933
Malacca ...	1,136	10,050
MALAYA ...	61,002	461,234

TABLE IV
DOMESTIC EXPORTS 4

AREA	For month	during the year 1933
Malay States ... / Straits Settlements	48,581	364,993
MALAYA ...	48,581	364,993

Notes :—1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.

2. The production of estates of less than 100 acres is estimated from the formula : Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month, + Consumption, *i.e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] + 14 tons local consumption during the month —[2]—[3]—[4]—[5]—[9]—[10]. For the Straits Settlements, Columns [9] and [10] represent purchases by dealers from local estates of less than 100 acres, reduced by 15 % to terms of dry rubber.

3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15; wet sheet, 25 %; scrap, lump, etc., 40 ; stocks elsewhere are in dry weights as reported by the dealers themselves.

4. Domestic exports are estimated by deducting the average monthly dry weight of foreign imports over a period of 2 months from the gross foreign exports of the later month, the foreign exports of the Malay States being domestic production.

5 The above, with certain omissions, is the Report published by the Registrar-General of Statistics, S.S. and F.M.S., at Singapore on 22nd November 1933.

METEOROLOGICAL SUMMARY, MALAYA, OCTOBER, 1933.

Locality	Air Temperature in degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent
	A. Max.	B. Min.	Mean of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet			Amt.	Precipitation .01 in or more	Precipitation, .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.								
Railway Hill, Kuala Lumpur, Selangor ...	89.7	71.3	80.5	94	69	79	75	83.7	84.7	7.60	193.1	1.87	15	13	5	10		184.15	5.94	49
Bukit Jeram, Selangor ...	87.6	71.8	79.7	90	69	80	74	83.8	85.6	6.02	152.9	1.54	19	17	2			198.80	6.41	53
Sitiawan, Perak ...	88.7	72.5	80.6	92	71	84	75	84.0	85.6	7.88	200.2	2.16	18	12	1	1		166.05	5.36	46
Kroh, Perak* ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Temerloh, Pahang ...	88.9	72.1	80.5	92	69	84	75	84.2	85.7	3.49	88.7	1.13	16	9	1	2		173.10	5.58	46
Kuala Lipis, Pahang ...	88.4	71.5	79.9	91	69	83	74	83.8	84.9	6.35	161.30	2.77	11	8	2	21		167.90	5.42	45
Kuala Pahang, Pahang ...	86.5	73.3	79.9	90	71	82	76	84.4	85.4	7.99	203.0	1.84	21	19	3			194.85	6.29	52
Mount Faber, Singapore ...	86.5	74.0	80.3	92	70	80	78	81.4	82.5	7.63	193.8	2.58	18	15	4			159.15	5.13	42
Butterworth, Province Wellesley ...	86.2	73.5	79.9	89	71	79	76	83.6	84.9	9.93	252.2	2.35	24	19			1	176.70	5.70	47
Bukit China, Malacca ...	84.5	73.2	78.8	87	71	81	76	82.5	83.9	14.08	357.6	3.73	15	31	1			197.35	6.37	53
Kluang, Johore ...	87.3	70.2	78.7	93	68	83	73	81.1	81.9	7.47	189.7	1.49	21	17			1	171.50	5.53	46
Bukit Lalang, Mersing, Johore	86.4	71.4	78.9	91	69	81	73	81.5	81.9	3.68	93.5	0.73	15	10	3	3		179.00	5.77	48
Alor Star, Kedah ...	86.0	73.7	79.9	90	71	78	77	84.9	85.9	13.53	343.7	2.86	23	20	3	2		171.05	5.52	46
Kota Bahru, Kelantan ...	87.8	73.0	80.4	91	70	84	75	84.0	84.9	10.87	276.1	2.67	18	16	3			198.65	6.41	53
Kuala Trengganu, Trengganu	87.0	72.2	79.6	89	70	82	75	83.0	84.5	9.33	237.0	1.57	19	16	3	2		193.75	6.25	52
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft. Pahang ...	73.8	62.5	68.1	80	61	69	65	71.0	71.7	4.75	120.7	0.72	16	14	2	12		143.90	4.64	38
Cameron Highlands, Tanah Rata, Pahang 4750 ft. ...	71.4	56.9	64.1	74	52	68	61	69.9	69.9	7.43	188.7	1.01	25	20	3	2	1	128.85	4.16	35
Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ..	70.6	58.7	64.7	75	57	65	61			6.99	177.6	0.99	22	19		1	1	127.15	4.10	34

Compiled from Returns supplied by the Meteorological Branch, Malaya

*This Station has been dismantled